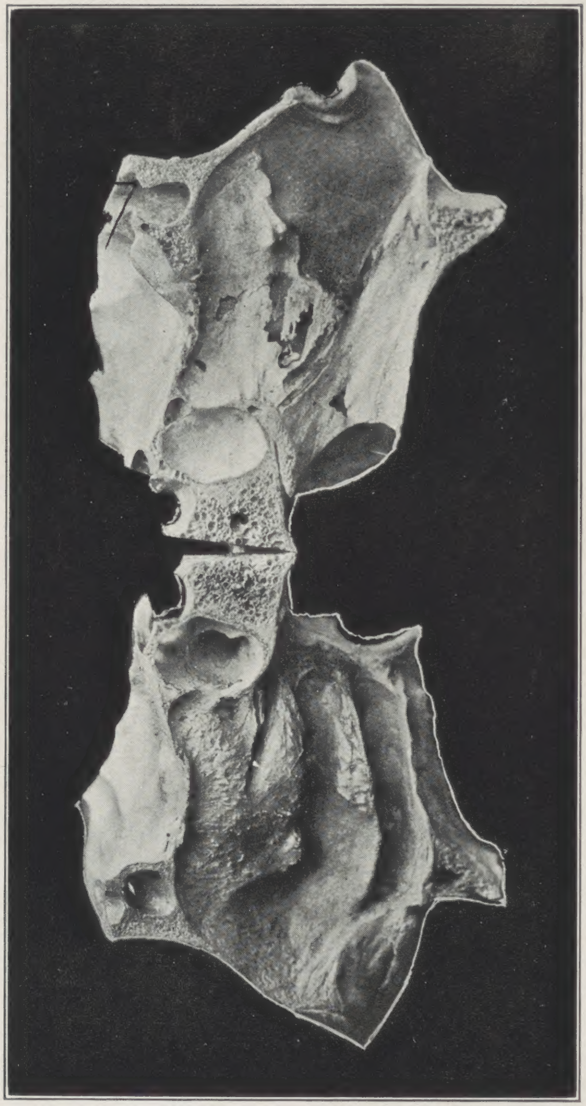

INTRANASAL SURGERY

BY

FRED J. PRATT, M.D., F.A.C.S.

ASSISTANT PROFESSOR, EYE, EAR, NOSE AND THROAT, MEDICAL SCHOOL, UNIVERSITY OF MINNESOTA

AND

JOHN A. PRATT, M.D., F.A.C.S.

ASSISTANT PROFESSOR, EYE, EAR, NOSE AND THROAT, MEDICAL SCHOOL, UNIVERSITY OF MINNESOTA

MINNEAPOLIS

ILLUSTRATED WITH 195 HALF-TONE ENGRAVINGS

PHILADELPHIA

F. A. DAVIS COMPANY, PUBLISHERS

1924

PRINTED IN U. S. A.
PRESS OF
F. A. DAVIS COMPANY
PHILADELPHIA, PA.

PREFACE

In our teachings, we have found doctors and advanced students vague in their knowledge of the anatomy of the nose, and especially of the ethmoidal region.

Some of the books are so technical and use such a multitude of terms that they are almost impossible to understand. Others, in describing an area, use so much text and bring in so many variations that the whole subject is confused. In describing operations, too much of the technic is taken for granted.

In this book, we have endeavored to arrange the chapters to avoid confusion, and some may seem elementary. To reinforce the text, we have used many illustrations.

The latest and recognized operations are described. The technic has been gone into in detail, each step has not only been described but the reason given for doing it that particular way, and then illustrated. Some of the technic and many of the drawings are original.

The drawings are anatomically correct and most of them are made from actual specimens. They were drawn by Jean Eleanor Hirsch in the Medical Art Shop of the University of Minnesota, assisted by Edith Sykes and Katharine Kingsbury.

The photographic work was done by Mr. Henry W. Morris, of the Department of Pathology, of the University of Minnesota. The text was typewritten, read and corrected by Miss Ina Sherlock. We wish here to thank all these for their painstaking care and interest in the preparation of this work.

We have taken liberally from books and articles whose titles will be found under Bibliography, and we would recommend them for further study.

If we have presented the matter in such a simple way that we have made it clear. we shall have accomplished our purpose.

CONTENTS

CHAPTER I.

Anatomy.

CHAPTER II

Functions of the Nose.

CHAPTER III.

Diseases of the Nasal Chambers.

CHAPTER IV.

Atrophic Rhinitis.

CHAPTER V.

Miscellaneous Conditions.

CHAPTER VI.

The Septum and the Submucous Resection.

CHAPTER VII.

Dips in the Nasal Bridge.

CHAPTER VIII.

Development of the Lateral Wall.

CHAPTER IX.

Localized Anatomy of the Lateral Wall.

CHAPTER X.

Head Pains.

CHAPTER XI.

Turbinates.

CHAPTER XII.

The Ethmoidal Cells.

CHAPTER XIII.

The Sphenoidal Sinus.

CHAPTER XIV.

The Frontal Sinus.

CHAPTER XV.

The Maxillary Sinus.

CHAPTER XVI.

Coronal Head Sections.

ILLUSTRATIONS

CHAPTER I.

Anatomy.

THE NASAL CHAMBERS.

THE nasal chambers are two more or less regular spaces, triangular in shape, situated one on either side of the middle line of face, extending from the base of the cranium to the roof of the mouth, and separated from each other by a thin vertical septum. They open on the face through the pear-shaped anterior nasal aperture or anterior nares; and their posterior openings, called posterior nares or choanæ, communicate with the nasal part of the pharynx. They are much narrower above than below, and in the middle than at their anterior or posterior openings; their depth, which is considerable; is greatest in the middle. They communicate with the frontal ethmoidal, sphenoidal and maxillary sinuses.

THE VESTIBULE.

Just within the anterior naris is the vestibule. It is a triangular pyramidal cavity, wider behind than in front. It is bounded on the median side by the nasal septum, and on the lateral side by the soft tissues of the nose. It is bounded by the anterior naris in front while the posterior margin

corresponds to a line dropping perpendicularly from the fronto-nasal suture, through the anterior end of the inferior turbinate body. It is therefore mostly within the soft tissue structure, but about one-quarter of an inch of it extends within the space bounded by the nasal bones. It corresponds to the external nose.

BOUNDARIES OF THE NASAL CHAMBERS.

Each of the main cavities is bounded by a roof, a floor, a mesial and a lateral wall.

THE ROOF.

The roof is horizontal in its central part, but slopes downward in front and behind; it is formed in front by the nasal bone and the spine of the frontal; in the middle, by the cribriform plate of the ethmoid; and behind, by the body of the sphenoid, the sphenoidal concha, the ala of the vomer and the sphenoidal process of the palate bone. In the cribriform plate of the ethmoid are the foramina for the olfactory nerves.

THE FLOOR.

The floor is flat from before backwards and concave from side to side, it is slightly wider behind than in front and slants downward from before backwards so that the level of the floor behind is about one-quarter of an inch lower than in

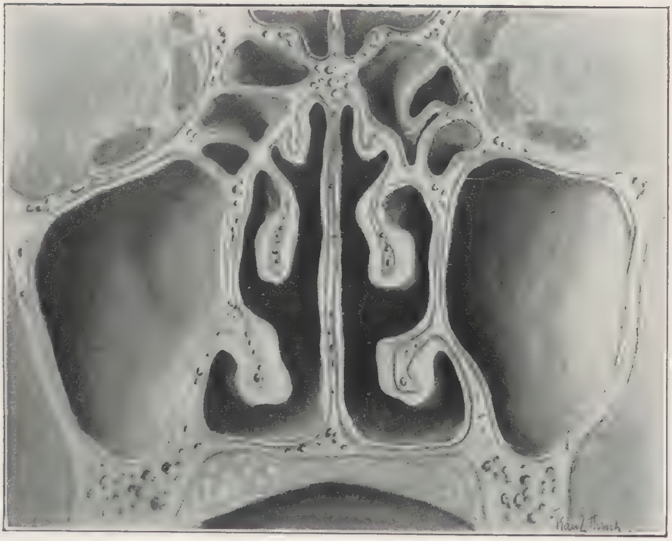

Fig. 1.—Cross section of a normal nose.

front. It is formed by the palatine process of the maxilla and the horizontal part of the palatine bone.

THE MESIAL WALL.

The mesial wall (septum nasi) is formed above in front by the crest of the nasal, the spine of the frontal bones and the triangular cartilage; above behind by the perpendicular plate of the ethmoid; behind by the rostrum of the sphenoid and the vomer; below by the anterior nasal spine, the crest of the maxillæ, the vomer and palatine bones. Its bony surface is marked by numerous furrows for vessels and nerves and by the grooves for the naso-palatine nerve and is traversed by the sutures connecting the bones of which it is formed.

THE LATERAL WALL.

The lateral wall is formed, in front, by the ala nasi, the frontal process of the maxilla and by the lachrymal bone; in the middle above by the superior and middle turbinates (conchæ), under which lie the ethmoidal sinuses, and below, the inferior turbinate; behind, by the vertical plate of the palatine bone, and the mesial pterygoid plate of the sphenoid.

THE TURBINATES (CONCHÆ).

The turbinate bodies, so named from their scroll-like appearance, are three in number and are located upon the lateral wall of the nasal chambers. They are covered with mucous membrane containing

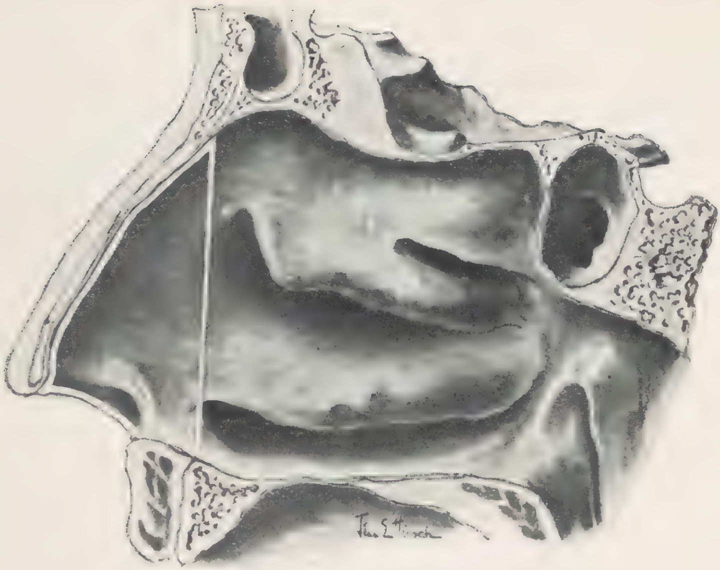

Fig. 2.—Vestibule of the nose outlined.

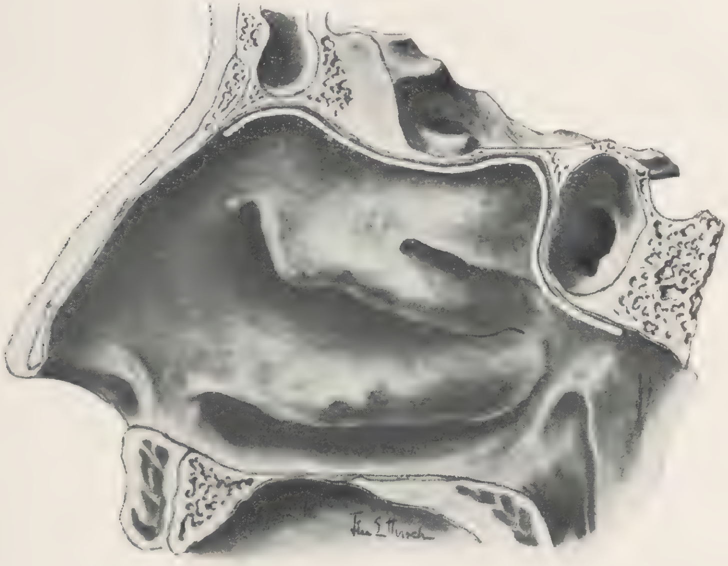

Fig. 3.—Side view of the roof of nasal cavity outlined.

venous plexuses, known as "swell bodies." They are called the superior, middle and inferior turbinates and are nearly parallel and approximately an equal distance from each other, and sub-divide the nasal passages into three channels called meati.

THE SUPERIOR TURBINATE.

The superior turbinate is not a distinct bone but a projection from the lateral mass of the posterior ethmoid, forming a ridge posteriorly while anteriorly it merges into the middle turbinate. It is much smaller than the other two turbinates and is located in the extreme upper and posterior part of the nasal cavity.

THE MIDDLE TURBINATE.

The middle turbinate is not an independent bone but a large overhanging appendage of the lateral ethmoid mass.

The attachment, starting posteriorly, follows the lower border of the superior meatus to its anterior end, then turns abruptly to the cribriform plate, curving forward to end at the agger nasi ridge.

The vertical line of the attachment separates the anterior from the posterior ethmoidal cells. The anterior ethmoidal cells lie under the anterior superior half of the turbinate, while the posterior half is simply an overhang.

A line drawn through the lower border of the middle turbinate divides the nasal chamber into about equal halves.

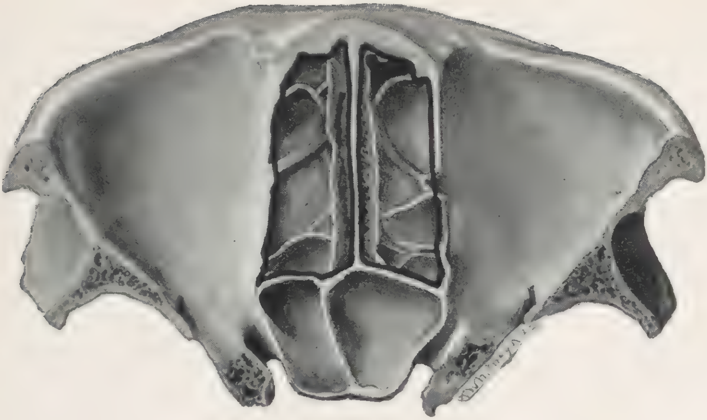

Fig. 4.—Roof of the nasal cavity.

Fig. 5.—Floor of the nasal cavity.

THE INFERIOR TURBINATE.

The inferior turbinate is an independent structure articulating anteriorly with the nasal process of the superior maxillary, centrally with the lachrymal and ethmoidal bones, and, posteriorly, with the crest of the palate bone. It is the largest of the three turbinates and its mucous membrane contains the greatest number of the "swell bodies."

MEATI OF THE NASAL CHAMBERS.

On the lateral wall are three irregular antero-posterior passages termed the superior, middle and inferior meati of the nasal chambers.

THE SUPERIOR MEATUS.

The superior meatus is the smallest of the three, and lies between the superior and middle turbinates. The posterior ethmoidal cells open into it. The sphenoidal sinus opens into a recess, the spheno-ethmoidal recess, which is placed above and behind the superior turbinate.

THE MIDDLE MEATUS.

The middle meatus is situated between the middle and inferior turbinates, and extends from the anterior to the posterior end of the latter. The lateral wall of this meatus can be satisfactorily studied only after the removal of the middle turbinate. Under the anterior part of the middle turbinate is a curved fissure, the hiatus semilunaris, limited be-

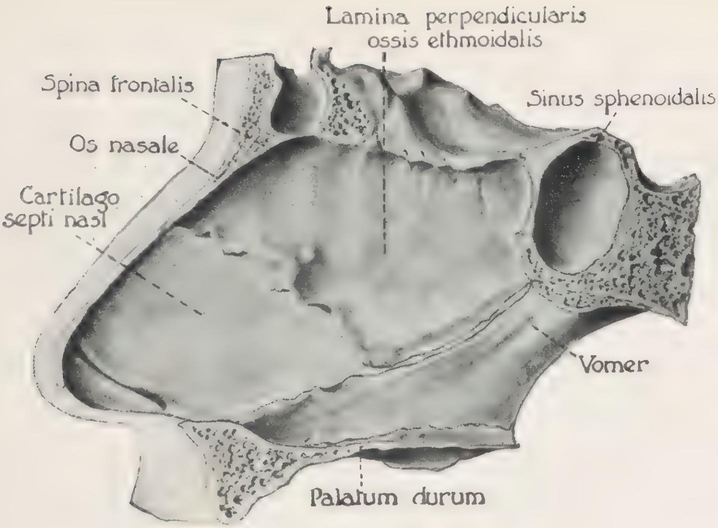

Fig. 6.—The nasal septum.

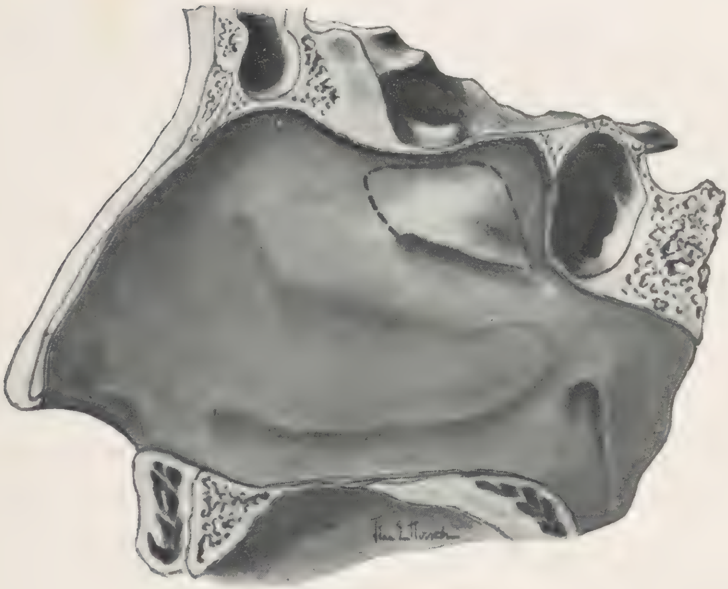

Fig. 7.—Superior turbinate and its attachment.

low by the edge of the uncinate process and above by an elevation named the bulla ethmoidalis. Above the upper end of the hiatus semilunaris is a funnel-shaped depression into which open the anterior ethmoidal cells and in about half the cases, the fronto-nasal duct. As we pass downward and backward this funnel-shaped depression, called the infundibulum, becomes a canal into the lower end of which opens the ostium of the maxillary sinus. The narrow part of this canal has a slit-like opening into the middle meatus. This slit is called the hiatus semilunaris.

THE INFERIOR MEATUS.

The inferior meatus, the largest of the three, is the space between the inferior turbinate and the floor of the nasal cavity. It extends almost the entire length of the lateral wall of the nose, is broader in front than behind, and presents anteriorly the lower orifice of the naso-lachrymal canal.

THE MUCOUS MEMBRANE.

The vestibule of the nose is lined with mucous membrane, continuous in front with the skin of the upper lip and the wings of the nose, and behind with the mucous membrane of the internal nose. In front, the epithelium is squamous, which gradually changes until at the posterior part of the vestibule, it becomes columnar and ciliated. Thick hairs or

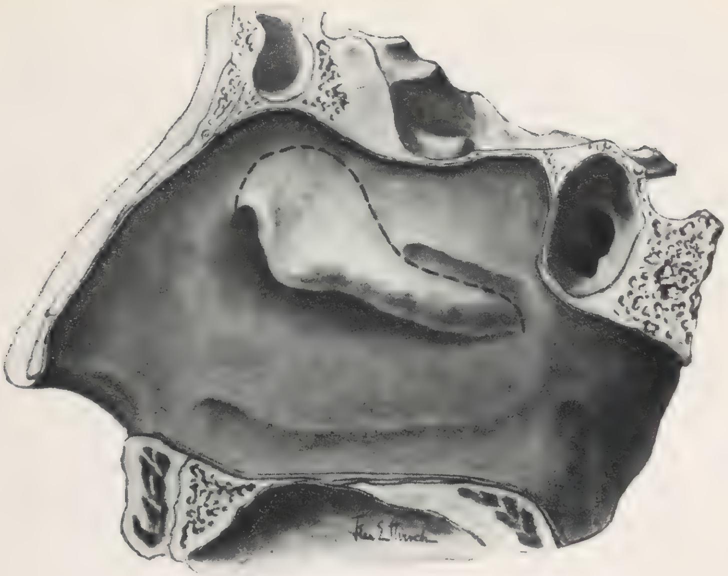

Fig. 8.—Middle turbinate and its attachment.

Fig. 9.—Inferior turbinate and its attachment.

vibrissæ line the anterior part of the vestibule and act as a filter to protect the inner chambers. The mucous membrane of the remaining nasal space is divided into two portions, the olfactory and respiratory. The olfactory portion occupies about the upper third of the nasal cavities. In this region, the mucous membrane is pigmented, being of light yellow color, at least in the white races. The epithelium is columnar and non-ciliated and is divided into supporting cells and olfactory cells. The supporting cells are tall cylindrical elements and the olfactory cells are the perceptive elements receiving the smell-stimuli.

The respiratory portion is the remainder of the nasal cavities and includes the meatuses together with all the accessory sinuses. The mucous membrane is lined with columnar, ciliated epithelium and varies greatly in thickness in the several parts of the nasal fossa, being the thickest over the turbinates and adjacent portions of the septum. The membrane lining the sinuses is thin and firmly adherent to the periosteum except around the ostia where it is rather thick and loose. Below the epithelium is a thick, hyaline basement membrane, and underneath this is a mucosa of fibrous tissue, with numerous lymph corpuscles in it. In many places, this infiltration with lymph corpuscles amounts to perfect lymph follicles. The mucosa contains, in its most superficial layers, a network of capillaries, and

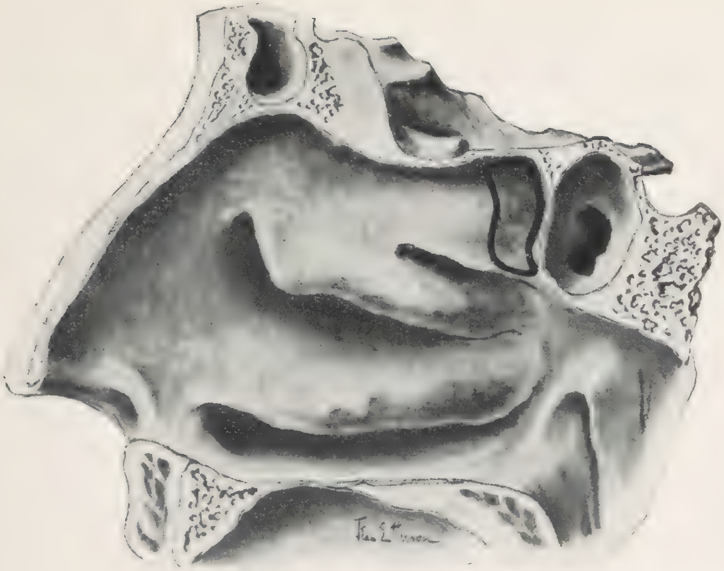

Fig. 10.—The spheno-ethmoidal recess outlined.

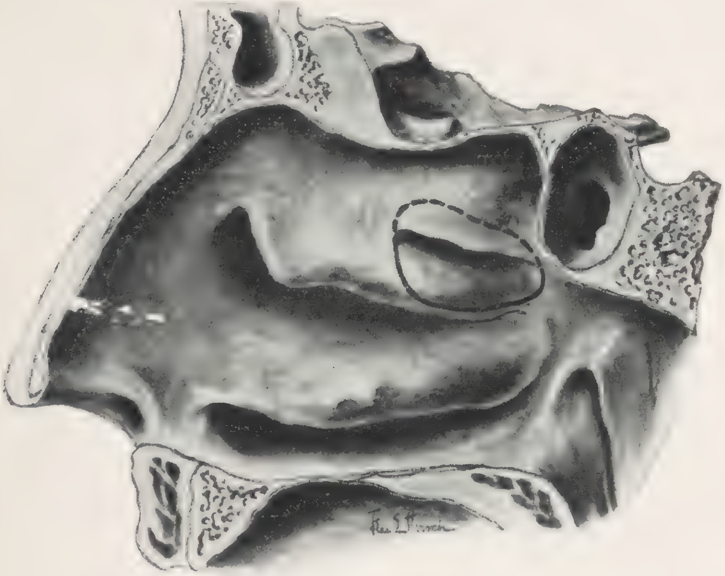

Fig. 11.—Superior meatus outlined.

in its deeper layers a rich and conspicuous plexus of venous vessels. In the mucous tissue covering the inferior turbinate, the lower margin and posterior extremity of the middle turbinate and less so over the posterior end of the superior turbinate, and the tubercle on the septum in front of the anterior end of the middle turbinate are especially well developed venous plexuses, known as swell bodies or erectile tissue of the nasal chambers. In these areas are found circular and longitudinal bundles of unstriped muscle tissue embedded in the walls of the venous plexuses.

THE GLANDS OF THE MUCOUS MEMBRANE.

In the anterior part of the vestibule are sebaceous and sudoriferous glands, while the posterior part contains the mixed seromucous glands. The mucous membrane of the nasal chambers is provided with a nearly continuous layer of branched mucus and serous glands, mixed in type, the ducts of which open upon its surface. The deeper end of the glands branch irregularly into tubes that bear the ovoid terminal alveoli. The latter are lined with mucous secreting cells, between which lie the crescentic group of serous cells that stamp the glands as mixed. In exceptional cases exclusively serous glands are also encountered. The glands are most numerous at the middle and back parts of the nasal fossa and largest at the lower and back part

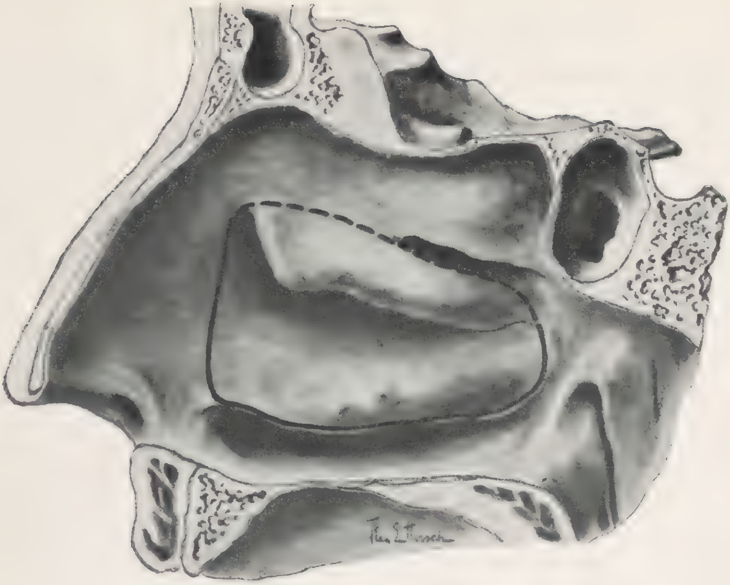

Fig. 12.—Middle meatus outlined.

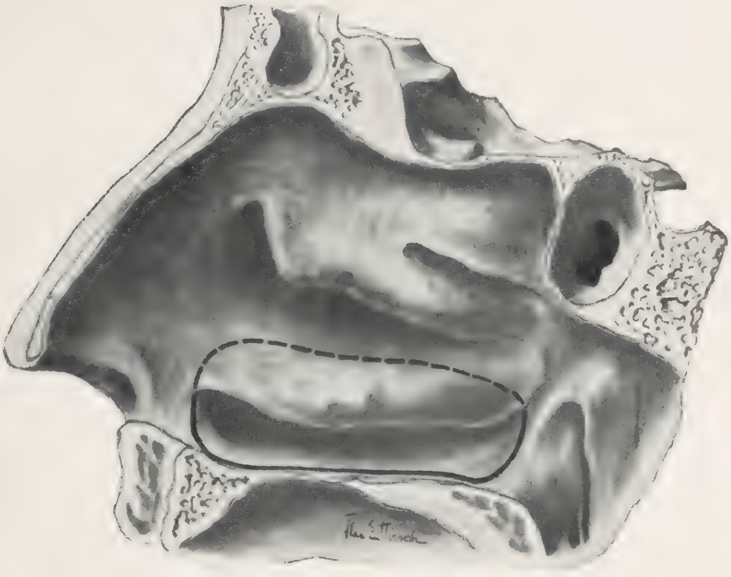

Fig. 13.—Inferior meatus outlined.

of the septum. The olfactory glands, or glands of Bowman, are characteristic of the olfactory region. They open onto the free surface by very narrow ducts, and from the character of their secretions are probably to be reckoned as serous and not mucous glands.

The mucous membranes of the sinuses have relatively few glands except in the membrane around the ostia where they are numerous.

JACOBSON'S ORGAN.

Mention should be made of a rudimentary structure found in man, almost constantly in the newborn child and frequently in the adult, known as the organ of Jacobson, in varying degrees of perfection, in all amniotic vertebrates. In many animals it possesses in a high degree the sense of smell. In man, if present, the organ is represented by a compressed tubular diverticulum, situated in the region of the articulations of the triangular cartilage, perpendicular plate of the ethmoid and the vomer, is about two-sixths of a millimeter in length, and passes backward to end blindly beneath the mucous membrane on each side of the nasal septum.

OLFACTORY SULCUS.

The olfactory sulcus is a channel-like space that lies at the upper junction of the lateral and mesial walls of the nose. It extends from the vestibule

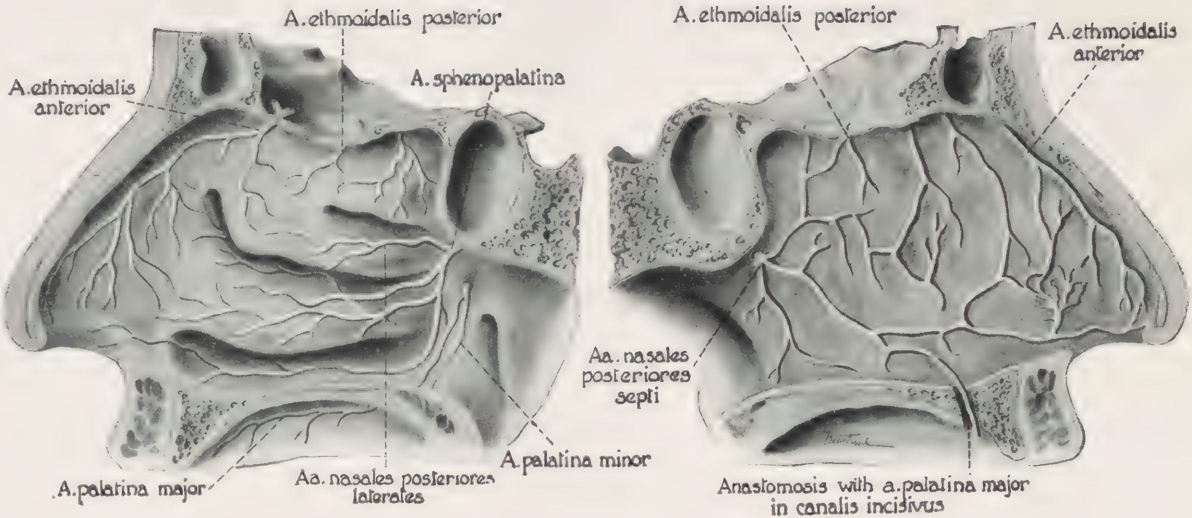

Fig. 14.—The blood supply of the nasal cavity.

anteriorly, along the inner surface of the dorsum of the nose, along the surface of the cribriform plate, to the spheno-ethmoidal recess. This channel undoubtedly gives direct passage to the olfactory region for the odoriferous gases.

THE BLOOD SUPPLY.

THE ARTERIES.

The arteries of the nasal fossa are anterior and posterior ethmoidal, from the ophthalmic, which supply the ethmoidal cells, frontal sinuses, and roof of the nose; the spheno-palatine, from the internal maxillary, which supplies the mucous membrane covering the turbinates, the meatuses and septum; and the alveolar branch of the internal maxillary, which supplies the lining membrane of the antrum. The ramifications of these vessels form a close plexiform network, beneath and in the substance of the mucous membrane.

THE VEINS.

The veins of the nasal fossa form a close network beneath the mucous membrane. Some of the veins accompany the spheno-palatine artery, through the spheno-palatine foramen; others join the facial vein; and some accompany the ethmoidal arteries, and terminate in the ophthalmic vein; and lastly a few communicate with the veins in the interior of the skull, through the foramina in the cribriform plate of the ethmoid bone, and the foramen cecum.

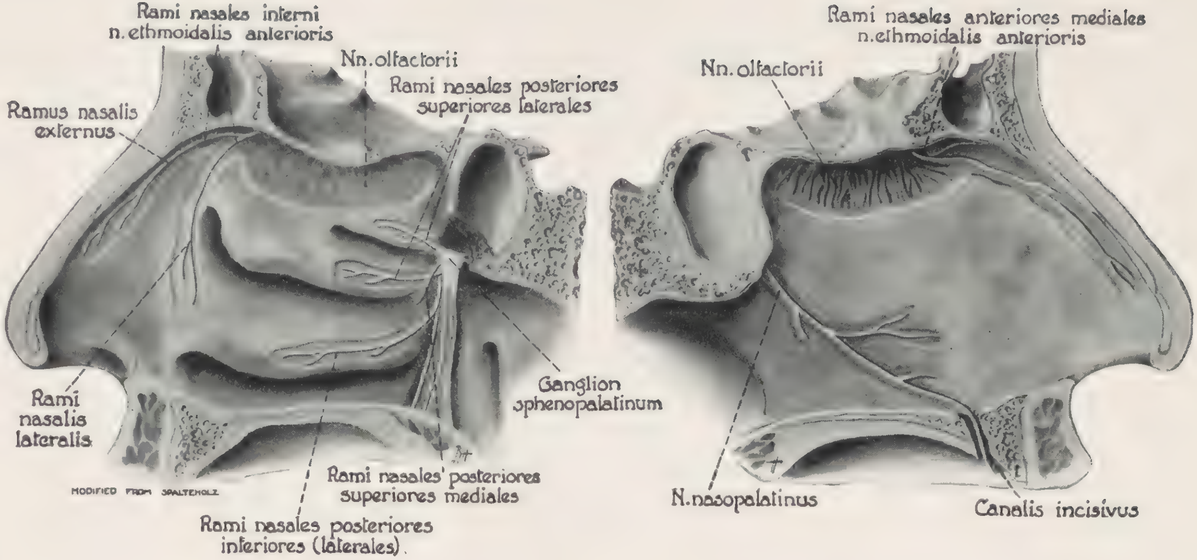

Fig. 15.—The nerve supply of the nasal cavity.

These venous communications explain many intracranial complications that frequently follow infections of the nasal cavities and paranasal sinuses.

THE NERVE SUPPLY.

The nerves are, the olfactory, the nasal branch of the ophthalmic, filaments from the anterior dental branch of the superior maxillary, the Vidian, naso-palatine, descending anterior palatine, nasal branches of Meckel's ganglion, and vaso-motor branches. The olfactory, the special nerve of the sense of smell, descends through the cribriform plate from the under surface of the olfactory bulb and is distributed in the mucous membrane covering the upper portion of the superior turbinate and a corresponding portion of the septum. The nasal branch of the ophthalmic distributes filaments to the upper and anterior part of the septum, and outer wall of the nasal fossa. Filaments from the anterior dental branch of the superior maxillary supply the inferior meatus and the inferior turbinate. The Vidian nerve supplies the upper and back part of the septum, and the superior turbinate; and the upper anterior nasal branches from the spheno-palatine ganglion have a similar distribution. The naso-palatine nerve supplies the middle of the septum. The larger, or anterior palatine nerve, supplies the middle and lower turbinates. Vaso-motor branches are also supplied to the vessels of the mucous mem-

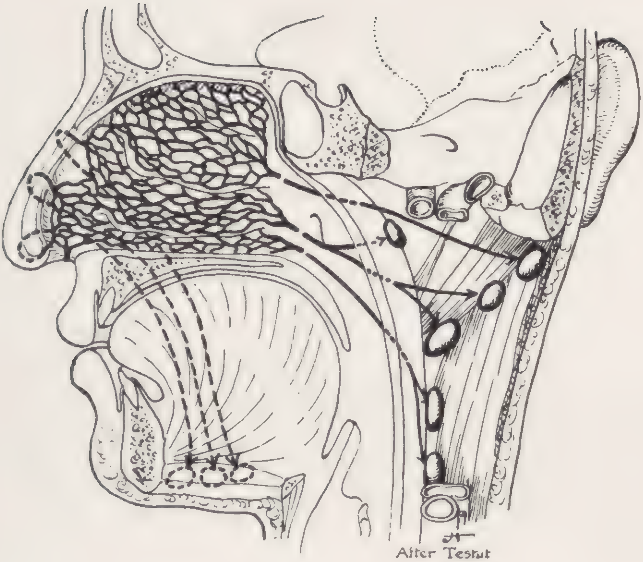

Fig. 16.—Lymphatic drainage of the nasal cavity.

brane and erectile tissue of the turbinated bodies from the spheno-palatine ganglion, and are under the control of the vaso-motor centers of the medulla; there is probably a connection with the nuclei of the vagus through association fibers. These accessory nerves over the septum and outer walls of the nose, and especially the branches from the spheno-palatine ganglion over the turbinates, probably explain the reason for the sensitiveness of these areas when the mucous membrane is inflamed. The association fibers, connecting the spheno-palatine ganglion with the vagus, establishes a physiological relationship between the upper and lower respiratory tracts.

THE LYMPHATICS.

The lymphatic network of vessels are located in the connective tissue of the tunica propria of the mucous membrane lining the nasal chambers, including the membrane of the paranasal sinuses. Their number are in direct proportion to the thickness of the mucosa. The main collecting vessels of the lymphatic network form an anterior and a posterior group. The anterior group is the smaller, and empty into the facial and the sub-maxillary group of nodes. The posterior is the larger and more important group and empties into the deep cervical chain or into the retro-pharyngeal nodes. Thus it will be seen that the direction of the principal drainage of the lymphatics is downward and backward.

CHAPTER II.

The Function of the Nose.

THE most important thing to know and remember when treating the nose is its function. If this is kept in mind the turbinates will not be removed and the membranes will be damaged as little as possible. No treatments, medical nor surgical, should be started until after the functions have been considered, together with what results the treatments will have upon them.

THE FUNCTION.

The functions of the nose are respiratory, olfactory, phonatory, gustatory, the ventilator of the nasal accessory sinuses and the ventilator of the Eustachian tubes.

THE AIR CURRENTS.

On inspiration, the main current of air passes up and in from the vestibule to the middle and superior meatuses. The anterior end of the middle turbinate divides the current, about two-thirds of the air going on the septal side and one-third under the turbinate through the middle meatus, it is then deflected downward and backward to the posterior nares (choanæ).

THE NASAL SPACING.

The septum not only divides the two nasal chambers, but acts as a wall to make definite spacing when the turbinates expand or contract to narrow or enlarge the chambers according to atmospheric changes. The mucous membrane of the septum thickens very little when the air space between the septum and turbinates is narrowed. The regulation of the size of the air chambers is performed by the erectile tissue in the mucous membrane covering the turbinates. When the space is to be narrowed, the erectile tissue swells and when the space is to be made more open, the erectile tissue contracts. It is therefore important that none of the functionating part of the turbinates be removed. If we are to obtain the utmost use of the nose, the septum must be straight, thin and in the middle line, and the turbinates of normal size and in place, thus, an equal amount of work, in modifying the air as it passes through, is performed by the two nasal chambers.

THE OLFACTORY FUNCTION.

The olfactory nerve, or organ of smell, is located in the upper portion of the nasal chambers. It passes through the cribriform plate and is distributed over the attic and about one-quarter of the way down on the lateral wall as far as the upper margin of the middle turbinated body and on the septum over a corresponding area. This function

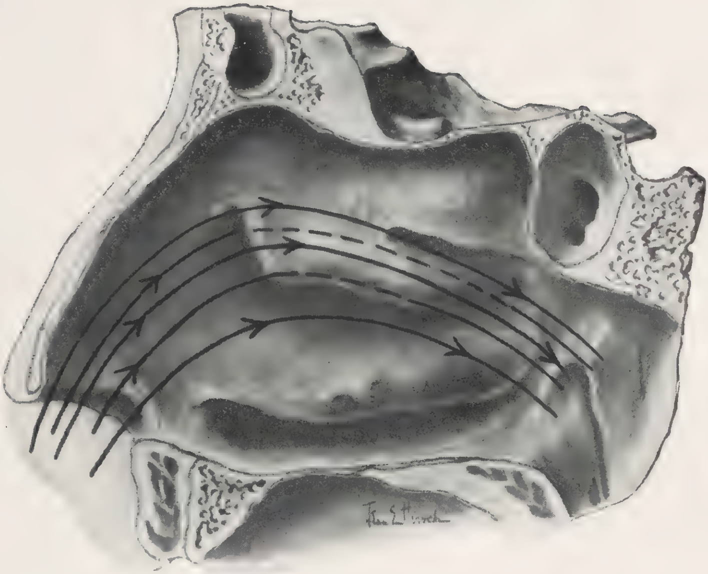

Fig. 17.—Direction of air currents through the nose.

is important not only for experiencing pleasant odors but to protect us against irritating substances like ammonia, and foul smelling and insanitary substances like decayed matter which might be in our food. The sense of taste is often lost when the function of smell is interfered with.

THE PHONATORY FUNCTION.

The nasal chambers and accessory cavities are of prime importance in voice production. They may be likened to the sounding box of a musical instrument and must therefore be free and clear and of as near an equal size as possible. As the sound passes through these cavities a resonance is produced which is essential for a good carrying voice.

THE GUSTATORY FUNCTION.

The gustatory, or sense of taste, is enhanced by the odor of food and drink reaching the olfactory nerves and in this way combining the odor with the sense of taste.

THE RESPIRATORY FUNCTION.

The respiratory is the most important of all the functions of the nose. As the air passes through the nasal chambers it is heated if cold, cooled if hot, moistened if dry, and the dust and dirt sifted out. In the submucous tissue of the membrane covering the turbinates are venous plexuses known

as the "swell bodies" or "erectile tissue" of the nasal chambers.

Cold Air.—When cold air is inspired, blood comes into the venous plexus, causing the turbinates to increase in size and to swell towards the septum, the space is thereby narrowed between the septum and the turbinates and the air goes through the chambers in a thin stream. With the extra blood in the venous plexuses come volumes of heat and the air being in a thin stream, it is rapidly heated on its way through the chambers. The temperature of the air, if cold when inhaled, is raised on its passage through the nasal chambers, to near body temperature. The delicate structures of the deeper respiratory tract are thereby protected against the greater variations and extremes of temperature.

Warm Air.—If the air is too hot, the reverse of the above is true, the blood goes out of the venous plexuses and the space between the septum and turbinates is widened. The air cannot be cooled as easily as it can be heated.

Dry Air.—The mucous membrane lining the nasal chambers contains glands which give off a serous secretion to supply moisture to the inspired air when it is too dry. It is estimated that about a pint or more of moisture is given off every twenty-four hours.

Filter.—The hairs (vibrissæ), in the vestibule of the nose, act as a coarse filter, the larger particles

of dust and dirt lodging here while the smaller ones enter the nasal chambers and are deposited on the moist mucous membrane. The nerves supplying the mucous and serous glands being irritated by this dirt, cause the glands to pour out a mucus and serous fluid to enmesh and wash off these particles. The cilia of the mucous membrane, by their wave-like action, carry them towards the posterior nares. Larger particles or more irritating substances stimulate the sensory nerve endings in the mucous membrane resulting in complex reflexes, causing sneezing, which is a violent blast of air through the nasal chambers to blow out irritating substances.

Micro-organisms.—Large numbers of micro-organisms enter the nose with the air. Someone has estimated that the lowest number is fifteen hundred inhaled every hour and must, in many cases, go up into the thousands. Most of them are caught by the hairs in the vestibule, and this region is swarming with organisms, the others are deposited on the moist mucous membrane of the nasal chambers. Here they become enmeshed in the mucus secretions which are poor culture media for bacteria, and with the washing effect of the serous secretion, and by the aid of the cilia of the mucous membrane, they are expelled from the nose. Any irritation of the mucous membranes of the nasal chambers causes the erectile tissue to swell. This means more blood in the venous plexuses and with

this blood, increased numbers of protective leukocytes. Fortunately, most of the micro-organisms are non-pathogenic and so do no harm. In cases of abrasions in the mucous membranes where the pathogenic germs could cause trouble, the increased number of phagocytes are usually able to take care of them. These things explain the reasons for the rarity of infections in the mucous membranes of the nasal chambers.

VENTILATION OF SINUSES.

The accessory sinuses, which open into the nasal chambers, must be ventilated by air to keep the mucous membranes lining them in a healthy condition, and must also have free drainage for their natural secretions.

FUNCTION OF SINUSES.

The frontal and maxillary sinuses make the bones which contain them both light and strong and these bones will crush before they will break, and so protect their underlying structures. The ethmoidal and sphenoidal sinuses, beside making their bones both light and strong have other functions. Their very location, being in the upper and lateral side of the nasal chambers indicate their use. On their outer side, separated only by a thin bone, are the eye cavities, with their delicate structures, and above, separated by a somewhat thicker bone, lies the brain. Because of their for-

mation, the air can interchange only slowly in these cavities during inhalation and exhalation. The cells are lined with mucous membrane and their total area gives a large surface to furnish heat and moisture to the inspired air. These numerous cavities, with their slow interchange of air and changes in temperature, act as insulators to the orbital structures and the brain.

EUSTACHIAN TUBES.

The eustachian tubes are outside the nasal chambers but their pharyngeal openings are just posterior to the posterior nares, so that for all practical purposes, the nasal chambers are but the continuation of these tubes. A clear passage through the nose is therefore essential for ventilation of the middle ear.

CHAPTER III.

Diseases of the Nasal Chambers.

THIS treatise deals only with those diseases causing changes within the nasal chambers, which later will lead to surgical interference to restore them as nearly as possible to their normal condition.

BACTERIOLOGY.

The studies of a number of investigators have shown that, although the entrance of the nose is swarming with bacteria, the flora of the nasal cavities proper, in health, are kept exceedingly sparse by the action of the ciliated epithelium, the trickling of the serous and mucus secretions, the inhibitory action of the mucus, it being a poor culture media, and by phagocytosis. Neumann, after an extensive and thorough bacteriologic study, summarized the results of his studies of the flora of the noses of one hundred and eleven normal persons and of ninety-five suffering from nasal affections of various sorts as follows:

The total numbers of bacterial species found were nineteen. In most cases there are relatively few species found present together. Most frequently are found diphtheroid bacilli and white micrococci. Less frequently orange, gray and yellow

micrococci, pneumococci, streptococci, Friedländer's bacilli, sarcina and a few other organisms. Micrococcus pyogenes albus is present in eighty-six to ninety per cent., diphtheroids in ninety-eight per cent of the cases, so that one can justly assert that the latter occurs in every sound and pathologic nose. The diphtheroid bacilli are not virulent and can be considered only as harmless saprophytes. Most of the changes in the mucous membrane and tissues of the nasal chambers have their beginning in the common cold. To date, the specific cause of a cold has not been found. Different investigators have found one form or another to predominate which would suggest an etiological relationship for that bacteria as the cause of colds. Certainly in the light of recent experience with influenza, the mere presence of bacteria in large numbers during an inflammation of the mucous membrane of the nasal chambers cannot be regarded as valid ground for considering them its cause. Anything that lowers resistance, general or local, may disturb the equilibrium between the host and parasite in the direction of exciting infection. Mudd states that certain bacteria are at once pathogenic when they reach the mucous membrane; at least in certain individuals. It may be that such individuals always present, owing to systemic states, conditions of the mucosa which offer an ever open avenue to infection, and it seems extremely likely that local bio-

chemical changes, dependent upon molecular activities acting through the sympathetic nervous system, are antecedent in the majority of cases of bacterial infection.

VASO-MOTOR CHANGES.

Long and general experience has shown that excessive exposure to cold and chilling of the body surfaces, cause a reflex vaso-constriction of the vessels in the mucous membrane of the nasal cavities, and are exciting causes of rhinitis. This molecular disturbance of the normal activities of the sympathetic nerves may be set up by external or internal agencies, by the chilling of the body surfaces, or by derangements in the activities of the internal organs. Owing to the fact that wet feet and the chilling of distant regions of the surface of the body are, at least in clinical experiences, quite as frequently followed by coryzas as the exposure of the head and neck, we have the right to infer that the shock at the surface must be transferred to internal nerve ganglia and there translated into impulses which are carried to the mucous membrane of the upper air passages; there they give rise to the chain of biophysical and biochemical changes which may simply result in a mild coryza, the resolution of which terminates the chain, or these conditions may be in themselves the starting point of bacterial invasion. In hot,

moist, crowded rooms, such as ill ventilated theaters or meeting halls, the mucous membranes over the turbinated bones and nasal septum become turgid with blood and lymph, and covered with a thick secretion. In such crowded places infection is likely to occur. On going out into the cold, moist, outer air, the blood vessels constrict and the nasal mucous membrane is chilled, but remains swollen with tissue lymph. This latter condition of the nasal mucous membrane with the tissue lymph affords a suitable medium for bacterial proliferation. The dangerous primary congestion is much less if the air in the room is kept circulating and is not over-heated. With the beginning of cold weather, cessation of summer out of door life, and beginning of hot air and steam heating, conditions of living become less favorable to general health and resistance. Opportunity for cross infection and for excitation of auto-infection by prolonged or excessive chilling, becomes more frequent, especially in crowded cars and meeting places. The mucous membranes are rendered more susceptible to infection by the close hot atmosphere, the bacteria gain a foothold, multiply and tend to increase in virulence as they pass from one to another susceptible mucous membrane, and so add another factor to the general tendency to increase the prevalence of respiratory infections.

INFLAMMATIONS.

Due to the following causes:

1. Acute infectious diseases, (being one of the prodromal symptoms).

2. Local irritants from occupations as;

   A. Dust (millers, furriers, etc.).

   B. Vapors (iodin, ammonia, etc.).

   C. Destructive forms (arsenic, mercury, etc.).

3. Lowered resistance, (digestive tract disorders, loss of sleep, etc.).

4. Exposures (cold, damp and changes in temperature).

5. Intranasal conditions (deflected septa, hyperplastic tissue, and in children, adenoids).

6. Infections (infected atmospheres in meeting places, street cars, etc.).

Acute Infectious Diseases.—As a rule, acute infectious diseases cause only a temporary change in the mucous membranes, which return to their normal condition with the termination of the disease.

Local Irritants.—Local irritants are important because they either destroy the membranes or cause repeated irritations and, in time, the membranes become thickened or hyperplastic.

Lowered Body Resistance.—When the body resistance is reduced by digestive tract disorders, fatigue and loss of sleep, the resistance of the mucous membrane is lowered and it becomes an

easy prey to infections when exposed to micro-organisms.

Exposure.—Exposures to cold or damp and changeable temperatures cause reflex changes in the mucous membrane and lower its resistance.

Infections.—Infection takes place when carried to mucous membranes, which are easily susceptible when exposed to extra micro-organisms and especially to those found in the atmosphere of meeting places and closed street cars.

Intranasal Conditions.—Intranasal conditions like deflected septa, hyperplastic turbinates, and adenoids in children by narrowing or partially occluding the nasal chambers, create a "stuffiness" by the least provocation of any of the other irritating causes.

ACUTE INFLAMMATION.

Exposure to cold, damp changeable temperatures together with infections, produce conditions known as colds or coryzas and cause the most typical changes in the mucous membrane of the nasal chambers. Children and young adults are more frequently subject to acute inflammatory diseases of the nose than the more mature adults, due no doubt to indiscretions, improper habits and insufficient clothing. Young children in our northern climate are not dressed properly during our changeable fall and spring months, and repeated acute inflammatory changes soon become chronic with all

the vicious conditions of the nose, throat and ears. With the onset of the cold, the vaso-motor constrictor muscle fibers of the arterioles are paralyzed and, as a consequence, there is a hyperemia of the venous capillaries, and the nose becomes "stuffed." There is also an increased migration of leucocytes and a transudation of lymph and serum. The production of the mucus is temporarily checked, but later is increased.

During the first stage, the secretions are greatly reduced in quantity or are entirely absent. In the second stage, the secretions are at first serous, and later become thick and viscid from the excessive degeneration of the goblet and granular epithelial cells. In the third stage, the secretions are muco-purulent in character. The swelling of the mucous membrane may not be great enough to close the lumen of the sinuses.

The inflammatory exudate is composed of serum, mucus, leucocytes, and exfoliated epithelium; the cilia become motionless, micro-organisms may or may not be present. The duration and course of the inflammatory process varies. The average case is completed in from eight to ten days. Resolution now sets in with a gradual reduction of the hyperemic and edematous swelling, the cilia resume their motion, and the secretions become mucoid, then of watery character and finally cease entirely and the membrane is returned to its normal condition.

CHRONIC INFLAMMATIONS.

Divided into the following groups:

Hypertrophies,
Hyperplasias,
Deflected septa,
Suppurative conditions,
Atrophic conditions.

HYPERTROPHIA (OVER-NOURISHMENT).

Hypertrophia of the mucous membrane means an increased blood supply and that the elements composing the tissue are simply increased in size or swollen, and when the congestion is over, the mucosa returns to its normal size.

HYPERPLASIA (EXTRA GROWTH).

Hyperplasia of the mucous membrane means an increased blood supply and an actual increase in the number of the elements composing the tissue so that the membrane is increased in thickness and size, and rarely returns to normal except under surgical interference. Acute colds and other irritants increase the blood supply to the mucous membrane of the nasal chambers and produce just a simple congestion of these tissues, which when the irritation ceases, returns to normal. If repeated congestions and irritations, which produce hypertrophy of the mucous membrane, are repeated again and again without returns to normal, the condition

changes from a hypertrophy to a hyperplasia. An actual permanent increase in the thickness of the membrane is then present. In the hypertrophic stage, the mucous membrane around the ostia of the sinuses becomes swollen, the opening closed and temporarily the drainage and aëration of the cells are interfered with. If the irritations are repeated before the membrane has a chance to return to normal, the hypertrophic stage is soon changed to the hyperplastic stage, and the mucous membrane around the ostia becomes so increased in size and thickness that the openings are actually closed. Some of the air within the sinuses is absorbed and as no more can enter, the air pressure is lowered and a vacuum created, the lining mucous membrane becomes swollen from this lowered air pressure, the blood supply is increased, and a serous exudate is thrown out, covering the mucous membrane. This forms a suitable culture medium for pyogenic bacteria if any be present. We have in these stages the repeated or continual nasal obstruction and the acute and chronic sinus diseases. Most of the changes in the membrane are over the turbinates, especially the lower and middle, and around the ostia of the sinuses, the membrane on the septum showing the least change.

DEFLECTED SEPTA.

Deflected septa and "spurs" on the septum make the nasal chambers unequal in size so that more

air passes through one side than the other. Nature, in attempting to equalize the air space enlarges the turbinates by hypertrophies or hyperplasias on the concave side of the deflection. Large volumes of air, together with the dust and dirt passing through the concave side, create a congestion in the turbinates on this side; which, after a time, produces a hypertrophy of the turbinates and so narrows the space. (It is a compensatory hypertrophy.) On the convex side the deflected septum presses on the turbinates, and nature tries to readjust the turbinates to make an adequate air space. As only a small volume of air can pass through, very little irritation is produced. The mucous membrane is thinned, which means a lessened blood supply, and in some cases even the bony part of the turbinate is reduced in size. (It is a compensatory atrophy.) This is not a destructive atrophy of the turbinates but a thinning out of the elements of the tissues. Under these conditions the turbinates do not have a normal functionating membrane, thinned tissue on one side and hypertrophic tissue on the other; one side the tissue is too thin, the other side it is too thick. If now we get some extra irritation, like a cold, the hypertrophic turbinates enlarge still greater, the thinned turbinates trying to enlarge are crowded back by the deflected septum, and we have a complete occlusion on both sides. The air is unable to reach the upper limits of the nose and sinuses, and the

sinuses are unable to drain themselves. As a rule, one side becomes more occluded than the other, depending on the size and position of the deflection. An apparently straight septum may be so thick, high up, that the air is prevented from reaching the upper limits of the nose and the sinuses, and the sinuses in turn, prevented from their normal drainage. A deflected septum or a thickened septum opposite the anterior part of the middle turbinate by pressure causes the most obstruction in the nose because the normal curve of the air currents is changed, and because of the occlusion of the ostia of the anterior ethmoids, frontal sinuses and antra which open under the middle turbinate into the nose at this point. These occlusions, at first cause only acute sinus conditions with slight changes in the mucous membrane lining the cavities, and later, if the membrane in these cavities becomes infected by micro-organisms, the acute condition is changed to a chronic or suppurative one.

SUPPURATIVE CONDITIONS.

As this treatise deals only with conditions which lead up to operative interference, diseases like tuberculosis, syphilis, gonorrhea and the specific exanthematous fevers, which require other treatment, will not be gone into. It is true they cause suppurative conditions and changes in the mucous membrane, but, as a rule, they are only temporary and call

for medical, rather than surgical interference. Nasal suppuration is rarely, if ever, a primary disease, but is invariably secondary to changes in the mucous membrane of the nasal chambers and sinuses of the nose, due to irritations of the membrane or to occlusions due to deflected or thick septa or to adenoids in children. The sinuses of the nose or their ostia occupy the upper and the narrowest half of the nasal chambers and the mucous membrane in this region shows the greatest change. The lower half of the nasal chambers, because of their size, never become entirely occluded but always have some drainage and therefore show no marked suppurative changes. During the stage of an acute congestion of the mucous membrane, the ostia of the sinuses are temporarily closed, aëration and drainage is interfered with and a serous exudate is thrown out which offers a suitable culture medium for micro-organisms. If this congestion lasts long enough and micro-organisms be present, we soon have the formation of pus and a condition called acute, suppurative sinusitis. When a suppurative condition has continued for from two to four weeks or longer, it has reached a stage that we call chronic. An acute condition might be said to be over when the patient has established his first immunity to the primary infection. At this point the acute condition goes on to resolution or, if the infection is not

completely conquered and drainage established, the condition drifts into the chronic stage. During this stage the patient has enough resistance to prevent death but not enough to prevent destruction within the tissues, or to conquer the infection. There are a number of things which cause acute conditions to become chronic:

First.—Anatomical conditions, as variations in the situation and size of the ostia of the sinuses, high deflections of the septa, septa thick between the middle turbinates, hypertrophied and hyperplastic middle turbinates, all of which interfere with normal drainage.

Second.—A special virulence of the infecting micro-organisms causing much destruction.

Third.—The susceptibility of some mucous membranes more than others to infections, therefore repeated attacks.

Fourth.—Repeated attacks of acute infections before the membranes have had a chance to recover from the first attack.

The discharge in the acute conditions is at first serous and then purulent with a variation in its consistency depending on the virulence of the micro-organism. In the chronic condition the discharge is purulent and variable as to consistency and amount. Old cases show very little or no discharge but easily light up with each new infection.

NASAL POLYPI.

Nasal polypi occur in chronic suppurative inflammations of the nasal chambers; found most often between the ages of twenty to thirty years and rarely in children. Why they occur in some and not in all cases of suppurative inflammations has not been explained. Many theories have been advanced as to the cause of polypi. A virulent infection or a long continued infection together with poor drainage, is one of the predisposing causes of polypi. They never grow from the roof or floor, and rarely from the septum or inferior turbinates. They most invariably arise from the lateral wall, and principally from the margin of the middle meatus and the cells of the ethmoidal labyrinth. In many cases the sinuses may be filled with polypi and not a single one visible in the nasal chambers. Polypi do not form, at least in the nose, except in the presence of an irritating discharge. A discharge running over the mucous membrane and especially around the ostia of the sinuses where the membrane is thick and loose, leads to edematous changes in the membrane. At the very edge of the ostia the membrane is thin and readily destroyed and the bone at this point is easily involved. Here, as a rule, polypi have their beginning. A polyp is not a new growth but an inflamed overgrowth of the structures normal to the part in which it originates. Hence, according

to its age and position, it may vary in structure from a simple edema of the mucosa up to what may be regarded as an edematous hypertrophy. A polyp consists of a loose fibrous stroma of which the meshes are filled with serous fluid. The surface is covered with epithelium, columnar and ciliated in part, and in part cubical. It may even be deficient. Glands, vessels, and nerves are found in the growth. The glands are especially numerous in the sessile and slow growing polypi. They may become obstructed or pressed on by inflammatory exudates, and in this way are formed the cysts which are often met with, particularly in polypi growing far back. Scattered through the growth, and more marked in rapidly growing polypi, are masses of inflammatory round cells. Veins are chiefly found at the bases of the polypi, and nerves are discovered with difficulty. Once drainage is established and the discharge stopped, the polypi quickly disappear, proving that infection and drainage are the exciting causes.

CHAPTER IV.

Atrophic Rhinitis.

Atrophic rhinitis non-fœtida is a disease characterized by progressive atrophy of the glandular tissue of the mucous membrane of the nose and turbinated bones, but later on involves the whole nasal mucous membrane including the olfactory portion and the mucous membrane lining the sinuses. The etiology of atrophic rhinitis is unknown and many theories have been advanced. The underlying cause is undoubtedly constitutional which produces changes in the blood supply and cell activity of the mucous membrane lining the nasal chambers. The resistance of the membrane being reduced, the various micro-organisms found in the nose have a chance to multiply and produce irritating discharges, which help to destroy the ciliated epithelium and glandular tissue and thus help along with the atrophy. The amount of this atrophy depending upon the constitutional resistance of the patient, the duration of the disease, and the virulence of the infection. No specific micro-organism for atrophic rhinitis has been discovered but all the usual germs in the air are found in the secretions from the nose. There are a few known diseases which contribute to the constitutional cause

of atrophic rhinitis as syphilis, tuberculosis, alcoholism, excessive smoking, anemia (as in women who suffer from constipation), dyspepsia, and uterine disorders. Other contributing causes are extremely dusty occupations, dry heat and the hot moist air found in laundries.

The following table gives some idea of the prevalence of the disease:

	Examined	Atrophic Rhinitis	Per cent.
Students	58	2	3.4
Workers, out doors	27	5	18.8
Workers, dry heat	26	9	34.6
Workers, moist heat (laundries)	46	21	45.6

SIMPLE CHRONIC ATROPHIC RHINITIS.

The underlying cause of simple chronic atrophic rhinitis seen in young adults is, in most cases, constitutional. The mucous membrane is pale and has a white edematous look and the surface is covered with a more or less thick slimy secretion, together with the dust and dirt of the air. The patient during the day blows out large quantities of this secretion which is more or less sticky and adherent to the membrane. After the membrane is cleaned, it looks somewhat pink but thin. The mucous glands are irritated and so produce the extra secretion but the cilia of the epithelium is being destroyed and the carrying off of the secretion is retarded.

The film of secretion lining the nasal cavities in drying shrinks and pulls away from the membrane,

a new film forms underneath which dries, shrinks and pulls away, this process is repeated until the chambers are filled with a cast of dry secretions. In workers in dusty places, the extra dust and dirt help to dry out the secretions and so hasten the atrophic condition. The hot, moist air of laundries produces atrophic conditions because the heat of the air, in which they work, reduces the blood supply to the mucous membrane, and the moisture in the air reduces the moisture produced by the glands in the mucous membrane. In time the blood-vessels and glands are reduced in number simply from non-use. In the meantime, the worker does not receive the proper modified air in the lungs and, eventually, the general constitution is affected. All constitutional diseases, as syphilis, tuberculosis, anemias, chronic focal infections, lesions of the heart, liver and kidneys produce changes in the mucous membrane of the nasal chambers which reduce their resistance and lead to atrophic conditions. The most important constitutional underlying cause of atrophic rhinitis lies with the ductless glands. No one knows just what part the ductless glands play or what changes they produce in the different tissues when they fail to work. From clinical studies, atrophic rhinitis is benefited when some of the gland substance is given internally. How they work, we do not know but probably while the system is being supplied by one of the

gland substances, this gland is stimulated to activity and it in turn, stimulates the other ductless glands and all together they supply something to the system which stimulates the mucous membranes of the nasal chambers, together with the other tissues of the body. Under this treatment the general constitution is improved, the blood supply in the mucous membrane of the nasal chambers is increased, the glands are stimulated and the atrophic condition is improved.

CHRONIC ATROPHIC RHINITIS.

Chronic atrophic rhinitis is of long duration and in most cases has its beginning at an early period, generally between the ages of seven and twelve years. It is more common in females than males and may be found in several members of the same family. Patients with large open nasal chambers are more subject to the disease. Children with long continued purulent discharge brought on by occlusions from adenoids or sinus infections, might in time, by the nature of the irritating discharge and the lowered body resistance, due to the nasal occlusion, and absorption of toxins, be changed from a hyperplastic sinusitis to an atrophic rhinitis. Undoubtedly in the writings of the past, the hypertrophic rhinitis of childhood preceding atrophic rhinitis was in reality a hyperplastic sinusitis. In atrophic rhinitis, the mucous membrane is atro-

phied, the ciliated epithelium becomes replaced by stratified epithelium and the glands atrophy. The capillaries and venous spaces are obliterated and the walls of the small vessels thickened. There is round cell infiltration around the vessels and glands, and the underlying tissue is converted into dense connective tissue. The whole process is one of diffuse sclerosis, but it does not necessarily take place uniformly, and it is not infrequent to find hypertrophies and even polypi in the region of the middle turbinates due to a purulent sinusitis while there is marked atrophy in the inferior turbinates. Atrophy also attacks the bony structures, but particularly that of the inferior turbinates, so that the middle turbinates appear larger by contrast. The secretion is thick and adherent and filled with cellular detritus, dust and dirt and teeming with micro-organisms. The cilia being destroyed, the secretion stagnates in the nose, putrefies, and losing its moisture by evaporation, dries into adherent crusts. There is no necrosis of bone nor ulcerations of the surface although abrasions of the mucous membrane may occur from forcibly detaching the adherent crusts. The drying and putrefaction of the crusts produce an offensive smell which the patient, as a rule, is unconscious of but of which his friends complain. The patient's sense of smell is lost early in the disease. The atrophic process may extend to the pharynx and larynx and at

times, even the ears are affected. The sinuses are always involved, especially the ethmoids and sphenoids and large quantities of irritating discharge from these cells dry in the nasal cavities, forming large crusts.

OZENA.

Ozena derives its name from the peculiar offensive odor which characterizes the nasal secretions. This secretion is more or less purulent, which dries in the form of crusts of a brown, yellow, green or black color. Ozena is probably an atrophic rhinitis, to which is added a germ infection which produces the odor.

TREATMENT.

Treatment divides itself into constitutional and local. Under constitutional treatment, all conditions like syphilis, tuberculosis, focal infections, heart, liver, kidneys and other organic conditions and anemia must have their special treatments. Constipation must be relieved and the general condition built up with tonics, fresh air and healthy occupations. For the ductless gland disorders, we have found clinically that suprarenal gland powder given internally, one grain three times a day over a long period of time, not only improves the patient's general condition, but tones up the mucous membranes of the nasal chambers. The glands are stimulated and produce more secretion so that

the patient, after a short course of treatment, is able to blow out crusts which before he could not loosen except by a water solution of some kind. The odor entirely disappears or is greatly reduced in intensity. Suprarenal gland powder does not cure atrophic rhinitis, but in nearly every case improves the patient's general condition and in that way, helps the atrophic condition. A few cannot take suprarenal gland powder as it increases their pulse rate and blood-pressure, so it is best to watch the patient when the treatment is first started.

LOCAL TREATMENT.

Local treatment must go along with the constitutional treatment and consists in removing the crusts, establishing good drainage from the sinuses and stimulating the mucous membranes to bring in more blood and to regenerate as far as possible, the ciliated epithelium. To reduce the drying effect of the air, if the septum is badly deflected, a submucous resection should be performed on the septum to equalize the size of the air chambers. If there is discharge, the sinuses are affected and should be operated to establish free drainage, care being taken not to remove any of the turbinates. At first an alkaline water solution will be necessary to loosen the crusts. After they have been removed, oily lotions should be used. Later the oily lotion

only will be necessary and should be used at least twice a day. Once a day some stimulating solution, like a five per cent. iodin in glycerin should be applied to the mucous membrane. The patient can do this by winding cotton on a stick applicator, dip in the iodin solution and apply to the inside of the nose. A hand suction pump used for five minutes on each side of the nose, once a day will bring more blood into the membranes by creating a vacuum within the nasal chambers and also help to empty the sinuses.

If the patient will persist in his treatment, wonderful results can be obtained. The patient should be informed that he will probably have to keep up some form of treatment as long as he lives. His mucous membranes are more or less scar tissue and the ciliated epithelium persists only in patches, the turbinates are shrunken in size, so that large volumes of air pass through the chambers unmodified. A nose in this condition will always need some watching.

After the crusts have about disappeared and the mucous membranes somewhat thickened, some operation can be tried to narrow the space within the nasal chambers. Paraffin is not satisfactory as it is a foreign body and the membranes are too thin to hold it. Beck has proposed the use of small splinters of bone from the ribs placed under the mucous membrane of the septum. Enough of the

mucous membrane over the septum on one side should be elevated to allow the splinter of bone to be inserted and the wound closed. If the bone takes, other pieces can be used later.

CHAPTER V.

Miscellaneous Conditions.

EPISTAXIS (NOSE BLEEDING).

BLEEDING from the nose, in the majority of cases, is due to a local vascular condition. It may come from general causes, and in some instances be a combination of both local and general. In at least ninety per cent. of all cases, the bleeding point is situated on the anterior portion of the cartilaginous septum, at a spot known as Kiesselbach's area. This is about one-quarter of an inch within the vestibule, and one-quarter of an inch above the floor of the nose. Here the mucous membrane over the cartilage is very thin, and contains a little vessel which is a branch of the internal sphenopalatine as it anastomoses with a branch of the superior coronary artery. The junction is often indicated by varicose leash of vessels. Bleeding from the nose is due, in most cases, to ulcerations of the mucous membrane in Kiesselbach's area or to traumatism, as from blows on the nose, or surgical operations which injure the vessels in this region. The general causes are high blood-pressure, acute infectious diseases, anemias, vicarious menstruation, rarefied air, and a few drugs as

salicylates or large doses of quinine. The cause of the bleeding should be ascertained if possible, as bleeding, for instance, in high blood-pressure should not be stopped too soon as nature is trying, in this way, to reduce the pressure. As a rule, bleeding occurs only on one side of the septum but may occur on both sides. Occasionally other areas in the nose will bleed.

In most cases packing the nose will stop the hemorrhage, or pinching the end of the nose with the fingers in many cases will suffice. If this does not stop it, more radical measures will be necessary. The best method is probably the electric cautery which destroys the vessels. Some strong caustic, like nitric acid, can be tried if used with a great deal of care, so as not to destroy too much mucous membrane. Cot has recommended raising the membrane like in a submucous resection over the area and packing for a few days to keep the membrane off the cartilage. After whatever method, the area should be kept soft with cold cream until healed to prevent the formation of too much scar tissue by the scabs being constantly pulled off.

ULCERATIONS OF THE SEPTUM.

Kiesselbach's area is the spot on the septum easiest reached by the finger, and is just behind the hairs in the vestibule. The mucous membrane is the thinnest in this area of any place on the

septum. Secretions from above in the nose are likely to be stopped in this region by the hairs of the vestibule and then dry together with dust and dirt from the air. In deflected septa, this is also a favorite area for dust and dirt to cling and form crusts. The patient, on attempting to remove the crusts with his finger, injures the mucous membrane by tearing them off with his finger nail. This, repeated for a short time, produces an ulcer. Being in Kiesselbach's area, more or less bleeding occurs each time the crusts are removed. When an ulcer heals, we have remaining scar tissue to which secretions stick and dry and produce a very annoying condition. If a patient continues to dig the crusts with his finger nail he is likely in time to pick a hole through the cartilage and produce a perforation. An ulcer may occur on one or both sides of the septum. Large ulcers on the mucous membrane expose the cartilage and a perforation quickly follows. If an ulcer gives much annoyance, it can be treated by performing a submucous resection on this part of the septum, removing the cartilage under the ulcer. The tissues remaining in the ulcer now receive a blood supply from the mucous membrane on the other side.

PERFORATIONS.

Perforations in the septum are due to ulcerations of the mucous membrane over the cartilage in which

the cartilage is exposed; abscesses in the septum, in which the bone or cartilage is destroyed; syphilis and traumatisms as in submucous resections, in which both flaps have been torn, the tears being opposite each other. The perforation itself is of no harm, and seldom gives much annoyance, beyond a certain tendency for mucus and dust to lodge on its margin. The membrane around the edge of the perforation is scar tissue or very thin mucous membrane to which the mucus and dust adhere.

The mucous membrane around the perforation should be deflected back as in a submucous resection and more of the bone or cartilage around the hole removed, allowing thicker edges of the mucous membrane to come together and so reduce the amount of scar tissue for secretions to stick to. Many operations have been devised to close perforations in the septum but all are more or less failures. All large perforations, and especially those far forward in the cartilage, cannot be closed. Perforations farther back, and especially those opposite the lower turbinate, can be closed by using this turbinate.

The method for closing perforations will be found in Chapter Six, under the heading, "Perforations."

HEMATOMA OF THE SEPTUM.

A blood tumor of the septum is generally due to an injury to the nose, as from falls or blows, or

to operations on the septum. They generally occur in the region of the cartilage, probably due to the cartilage being in the most exposed part of the nose and so easily fractured. As a rule they are bilateral, a little larger on one side than the other and have a smooth, rounded elevation with an elastic feeling to the probe. Shortly after an injury, the nose becomes obstructed together with some pain and stuffiness. If left alone the clot is absorbed or becomes organized. In the latter case, the swelling becomes firmer as it diminishes in size. In other cases it suppurates, and the swelling becomes soft and fluctuates. If the swelling is of any size it should be incised freely at its lowest point and drained. It should be inspected each day to prevent refilling.

ABSCESS OF THE SEPTUM.

An abscess follows an injury to the nose if the wound becomes infected. As a rule it is in the region of the cartilage of the septum, and is due to an infection of the blood clot following an injury to the septum, or a septic wounding of the septum. It resembles a hematoma in shape and size but has more fluctuation especially from side to side. The nose is painful to touch, especially if the end is pressed upon. An abscess is distinguished from a gumma by the history, the youth of the patient, the symmetry of the bilateral swellings, and

their position over the cartilage of the septum. A gumma occurs in older subjects, is unilateral, less painful, does not fluctuate, and the surface is uneven and depressed instead of bulging. It is usually farther back, over the bony part of the septum. The cartilage becomes involved in an abscess and the amount of cartilage destroyed depends upon the virulence of the infection and the duration of the disease. There may be both a necrosis of the cartilage and a sloughing of the mucous membrane, with a perforation as the result. If the abscess occurs high up and is of some size, the cartilaginous bridge of the nose may fall in when the abscess heals, leaving the tip of the nose with an upward tilt.

Abscesses following a submucous resection form a pocket, as a rule in the lower posterior part of the septum. An abscess should be opened freely at its lowest point, the cavity washed out and a small drain put in the cut. It is generally sufficient to make the cut on one side only. It is necessary to watch the drainage each day until healing takes place.

RHINOLITHS.

Rhinoliths in the nose are more or less irregular in size and shape depending upon the cavity in which they originate. The surface is hard and rough like a mulberry and generally gray or brownish-black. They consist chiefly of phosphate of cal-

cium, although phosphate of magnesia, chloride of sodium, and the carbonates of lime, magnesia, and soda and various organic bodies, such as mucin and protein, are also met with. The salts originate from the nasal mucus to some extent, but still more so from the tears. The salts are deposited around a nucleus of some foreign body, or perhaps some blood-clot or inspissated mucus. The rhinolith causes a more or less one-sided obstruction with an irritating discharge depending on the size and length of time it has been in the nose. It may be impossible to make a complete diagnosis until the rhinolith has been extracted. If it is of some size, it will be wedged into the nasal cavity and it will be necessary to use some care in removing it. Once completely removed, there is no tendency for it to recur. The cavity should be treated with an oily lotion and inspected for possible sinus disease.

FOREIGN BODIES.

Foreign bodies, like parasites in the nose, require medical and not surgical treatment. Young children are likely to put different objects like wads of paper, buttons, etc., into the nose, generally on one side only. A profuse especially one-sided nasal discharge in young children should be looked on with suspicion and carefully examined for a foreign body. These must be removed with care so

as not to injure the turbinates, and the nose should be treated with an oily lotion.

ADHESIONS.

Adhesions in most cases follow surgical operations on the nose. They may also come from irritations like an acute rhinitis where the mucous membrane becomes eroded and the swollen turbinate rubs against a spur or the septum, and attaches itself. Adhesions are most likely to occur, especially after operations, between the middle turbinate and the septum, as the nasal chambers are the narrowest in this region, also between the lower turbinate and spurs on the septum, as sharp angular spurs occur most often opposite the lower turbinate. They vary in extent and size and, if they follow surgical operations, it is better to let them heal and scar down. Scar tissue is poorly vascularized and when the adhesions are severed they are less likely to re-occur. If the adhesion is opposite the lower turbinate, after it is severed, a wax plate can be used to keep the parts separated. The wax plate should be left in the nose a week or ten days until the healing is completed. Adhesions should be watched and a probe passed through the nose every few days until the raw surfaces heal.

ANOSMIA.

In most cases odors are prevented from reaching the olfactory nerves by occlusions in the upper

part of the nose. There may be some change in the nerves due to constitutional causes as influenza, lead-poisoning, tobacco-smoke, syphilis, etc., or to some injury to the nerve endings in the olfactory mucous membrane, or due to atrophic rhinitis or to the habit of sniffing water solutions containing astringents like carbolic acid or alum. The sense of taste depends somewhat upon the sense of smell, its loss reducing the sense of taste. If due to an occlusion, it must be bilateral as one side of the nose is sufficient for the perception of odors. All cases of loss of smell, due to occlusion, will have their function restored as soon as the occlusion is relieved, the other cases must be treated according to their cause.

TUMORS.

Tumors in the nasal chambers are comparatively rare, and innocent tumors are more uncommon than malignant ones. The benign neoplasms met with in the nose are papilloma, fibroma, angioma, osteoma, enchondroma, exostosis and cysts.

Papilloma is one of the rarest of new growths found in the nose. They vary in number, size and extent, and have a smooth, rough or mulberry surface, and are generally attached to the septum, more rarely to the inferior turbinate. The growth is movable and the pedicle narrow. It either is gray or has a dull red color and is apt to bleed, though

not profusely, when touched. The microscope may be necessary, in doubtful cases, to distinguish it from a malignant tumor. The growth, if small, can be removed with a snare and the base cauterized with the electric cautery or chromic or nitric acid. If it occupies the whole nasal cavity, some more radical external operation will be necessary. An apparent recurrence may be due to an accessory papilloma overlooked at the first operation because of its size.

Fibroma.—Fibromas are exceedingly rare in the nose. They generally have their origin at the posterior end of the middle turbinate and occasionally from the inferior turbinate, and, as a rule, grow into the postnasal space, though they may grow anteriorly. The growth is firm and irregular, but with a smooth surface. It is dusky gray or pink in color, dense and firm to the touch, and not very vascular. The growth can nearly always be removed with a snare, but in some cases it may be so large that there will be considerable difficulty in getting the wire of the snare around it.

Angioma.—A pure angioma is rarely met with, and most of the vascular growths encountered are fibro-angiomata. The growth generally springs from Kiesselbach's area on the cartilaginous septum. It is either sessile or attached by a thin pedicle and bleeds easily. It is round and generally smooth but it may be lobulated. It varies in size

from a small pea to a hazelnut, although it may, in rare instances, assume a larger size. It may also originate from the anterior end of the lower turbinate. If the growth has a pedicle it can be removed with a snare, closing the loop slowly to allow the blood to clot. After which the base should be cauterized with an electric cautery. If it is sessile, an incision should be made in the mucous membrane in front of the growth and with a submucous elevator, peel the perichondrium containing the growth off the septal cartilage and carefully dissect it out.

Osteoma.—Osteoma is a rare form of neoplasm. The hard ivory variety is met with more frequently than the soft cancellous. It originates from the ethmoidal region, septum, or floor, and may be attached by a short, slightly movable pedicle. The size varies from a pea to a goose egg. In adults they can be left alone if not causing inconvenience. Hutchinson states that most osteoma grow during the growth of the body and cease to grow when full development has been attained. Small growths can be removed with a hammer and chisel, or tong forceps, larger ones will need an external operation.

Enchondroma.—Enchondroma is very rare, and liable to degenerate into chondrosarcoma. It is met with generally in young males. It most often grows from the ethmoid, but may arise from the lower lateral wall, the septum and from within the max-

illary sinus. The growth may be removed intranasally but if of any considerable size, an external operation may be necessary.

Exostosis.—Exostosis is more common. It is met with on the floor of the nose and lower part of the septum. It is sessile, rounded, and smooth and covered with unaltered mucous membrane. It is painless, very hard to touch, seldom attains much size but may cause obstruction. A chisel and hammer will be necessary to remove it.

Cysts.—Cysts generally arise from the floor of the nose just behind the vestibule. They may be associated with dental trouble. They are sessile in character, fluctuate on pressure, and are filled with a thin, pale yellow fluid. The cyst may remain stationary for years and give no trouble, or it may enlarge and cause local discomfort. If it is small, it is sufficient to incise it and allow the contents to escape. This treatment may have to be repeated. If the cyst is larger, it is better to dissect it out through an incision in the gingivolabial fold.

MALIGNANT NEOPLASMS OF THE NOSE.

Malignant growths are not very frequently met with in the nose. Primary carcinoma is rare. Sarcoma is not so uncommon. Carcinoma is met with in the form of squamous epithelioma, or alveolar carcinoma, chiefly in advanced age. Any of the varieties of sarcoma may be met with in the

nasal fossa. Malignant growths may originate anywhere in the nose, but particularly in the ethmoidal labyrinth and the palatine process of the superior maxilla at the junction of the floor and septum. More rarely they grow from the septum, though sarcoma is not uncommon here. The growths may be pedunculated or sessile, and by ulceration, may secure fresh attachments; still, a tumor may fill a nasal chamber and even some of the accessory sinuses, and yet only be attached by its point of origin. A rapid growing tumor, which bleeds freely and persistently should be looked on with suspicion and a small piece should early be examined under the microscope. If found when the growth is small, it can be removed, the base deeply cauterized and then treated with radium. Unfortunately many cases only present themselves when far advanced. Then, only some radical deforming external operation can be tried, to remove as much of the growth as possible, hoping that x-ray or radium will retard the growth of the remaining cells.

CONGENITAL OCCLUSION OF THE ANTERIOR NARES.

Occlusion by a congenital web of the skin at the junction of the vestibule with the nasal chamber proper is met with very rarely. It may be partial or complete, and unilateral or bilateral. If the web obstructing the nostril is thin and membran-

eous and of low vitality, a simple method to destroy it is with the galvano-cautery. As the web is similar to skin, it will be necessary to inject an anesthetic into the tissues around the edge to get anesthesia. Too much tissue must not be destroyed with the galvano-cautery at one sitting to prevent deep sloughing with resultant scar tissue. If the web is more fleshy in character, and it is more apt to be of this nature when it is incomplete, it is necessary to remove it with a knife, so as to leave as much epithelial tissue as possible, and avoid retraction. In some cases parts of the web can be turned down to cover the raw surfaces.

CONGENITAL OCCLUSION OF THE POSTERIOR NARES.

This is a comparatively rare condition, and is due to defect in development. The obstruction of the posterior nares is, in most cases, bone but may be partly membrane and partly bone. It may be unilateral or bilateral, and be complete, or have a small opening in it. In removing it, as large an opening as possible should be made, preferably with a burr which cuts the hard bone easily, but a chisel and hammer can be used. It should be watched to prevent granulations and a closure of the opening.

EXTERNAL DISEASES.

Some external symptoms and diseases have their origin within the nose, due to congestive or suppurative conditions. The nasal (Meckel's or spheno-palatine) ganglion occupies the upper part of the spheno-maxillary fossa just behind and above the posterior tip of the middle turbinate bone. Its sensory roots come from the maxillary division of the fifth nerve. Its motor root is the great superficial petrosal, arising from the seventh nerve, which joins the great deep petrosal, which is the sympathetic root, to form the Vidian nerve which enters the spheno-maxillary fossa to join the nasal ganglion. These nerves lie in very close relation to the paranasal cells, especially the sphenoid. The nasal ganglion sends branches to the sphenoidal and ethmoidal cells, the periosteum of the orbit, the mucous membrane of all parts of the nose, the roof of the mouth, the soft palate, the tonsils, and the naso-pharynx. Through its sympathetic root it is connected with the superior cervical sympathetic. An inflammation within the nose or paranasal cells may easily affect the nasal ganglion or its branches. The symptoms arising from such involvement vary greatly and may be divided into a neuralgic and a sympathetic type. Of the neuralgic type there is pain in the base of the nose, in and about the eyes, the upper jaw and teeth, and sometimes the

lower jaw and teeth, extending backward to the temple, the zygoma, the ear, the mastoid, being especially severe just back of the mastoid. It frequently extends to the occiput and neck, the shoulder, arm, forearm, and even to the hand and fingers. The sympathetic symptoms resemble the ordinary symptoms of hay fever as severe sneezing, profuse nasal discharge, itching, burning and congestion of the eyes, with lachrymation. Work requiring near vision is difficult or impossible. Suppurative conditions within the sinuses may be the foci of infection, affecting other parts of the body, as for instance, the joints in inflammatory rheumatism, though more often the eye becomes involved. Here we may have iritis, corneal ulcers, glaucoma, phlyctenular and interstitial keratitis, episcleritis, panophthalmitis, and even atrophy of the optic nerve.

HAY FEVER.

This book deals with hay fever only in so far as surgical interference within the nasal chambers benefits this disease. Most hay fever patients have deflected or thick septa or both together with hypertrophic turbinates and congested sinuses, in other words, a nose that is not normal even between attacks. Operative interference to straighten up and thin the septum, together with establishing sinus drainage if necessary, which then allows the turbinates to return to their normal condition will

cure or greatly relieve many cases of hay fever. The relief comes because the nasal chambers remain open during light attacks of hay fever and in the more severe cases, do not become stuffed as early in the disease or become so occluded during the progress of the disease. The stuffiness of the nose is one of the first symptoms and the most lasting. A hay fever victim is comparatively happy as long as he can breathe through his nose.

ASTHMA.

Asthma, while a bronchial syndrome, is closely related to changes within the nose through nerve association. Associate nerve fibers, connecting the spheno-palatine ganglion with the vagus, establishes a physiological relationship between the upper or nasal and the lower or bronchial respiratory tracts. Vaso-motor nerve branches are supplied to the vessels of the mucous membrane and erectile tissue of the turbinated bodies from the spheno-palatine ganglion, and are under the control of the vaso-motor centers of the medulla, there is probably a connection with the nuclei of the vagus through association fibers. These nerve associations probably explain the reflex reason for asthma due to nasal conditions when the mucous membranes of the nasal cavities together with the paranasal sinuses are inflamed. Many asthma cases are cured, and others benefited, when congestive or suppurative conditions

within the nasal cavities are relieved. The septum should be straightened and thinned, and above all things, any suppurating sinus should be drained. Good drainage and aëration of the sinus must be established if any relief is to be expected.

USE OF OIL.

The nasal chambers are respiratory organs and only air is intended to pass through them. They are lined with mucous membrane having a delicate ciliated epithelium, and within the mucosa are glands both serous and mucous. These glands keep the membrane soft and pliable, wash off all irritating substances and, together with the cilia, carry them out of the nose. This gland substance also is a poor culture medium, and in this way inhibits the growth of bacteria. It has been the custom, in the past, to use alkaline washes of all kinds to keep the nasal cavities clean. As a rule, the antiseptic drugs in these solutions are used too strong, they destroy the delicate cilia and wash off the protecting coat put on by nature. The membranes are now open to infection. If the solutions are used for some time, the membranes become tough and leathery, and the proper function of the nose is lost. Therefore water solutions of any kind should not be used in the nose.

Menthol, camphor, oil of eucalyptus and thymol, if used in small amounts in a bland neutral oil

base, are soothing to the mucous membranes. This oil does not destroy the delicate cilia and besides soothing the membranes, keeps them soft and pliable, especially in cases of colds or irritating discharges from the sinuses. These discharges wash off the natural protective coating and cause irritations to the membranes. The oil should be put in the nose with a short nose medicine dropper. Atomizers, except those used with air pressure, do not give enough oil nor throw it high enough into the nose. About three or four drops of oil are to be used at a time in each side of the nose and to be used two or three times a day. Care should be used to keep the oil out of the rubber cap, otherwise the rubber is soon destroyed. The patient should lie on his back, keeping the chin up, the finger closing one nostril and as the oil is dropped in the other nostril, it is sniffed forcefully. The idea is to carry the oil with the air currents into the upper limits of the nose.

Fig. 18.—Position of patient when using oil in the nose.

CHAPTER VI.

The Septum and the Submucous Resection.

THE NASAL SEPTUM.

The nasal septum is the partition between the two nasal chambers, and should, when normal, be absolutely perpendicular and have parallel surfaces so as to divide the two chambers into cavities of equal size. It also acts as a wall to allow the turbinates, by their expansions and contractions, to regulate the spacing within the nasal chambers.

EMBRYOLOGY.

The median fronto-nasal process is early divided into two lateral processes and two mesial processes. These form the walls of the primitive nasal fossa. The mesial nasal processes fuse in the formation of the central portion of the upper lip and the primary nasal septum. The primary nasal septum is at first thick, separating widely the early olfactory fossa, but gradually becoming thinner and thinner to occupy its position in the midplane. A laminar plate of cartilage develops in its substance. Portions of the laminar plate of cartilage remain and form the triangular cartilage and the vomerine cartilage, and other parts are replaced by bone.

Subsequently, the primary septum grows backward towards the pharynx and downward towards the mouth in the formation of the secondary septum, ultimately fusing with the nasal surface of the palate and forming a free border posteriorly between the posterior nares. This secondary portion is relatively thin, and later ossifies to form the perpendicular plate of the ethmoid and the vomer. The permanent nasal septum is therefore made up of primary and secondary portions, both derivatives of the mesial part of the fronto-nasal process. The nasal septum passes through three distinct stages. First, the membraneous; second, the cartilaginous, and third, the adult mixed cartilaginous and osseous. A fairly heavy mucous membrane covers both surfaces of the septum. The glands of the nasal mucosa develop as solid processes during the third and fourth months, but do not reach their complete development until after birth. The mucous membrane of the nasal septum of the fetus usually presents well developed folds in the region of what is later the vomer (septal folds). These septal folds and intervening furrows increase in size until the seventh or eighth month, then undergo a retrograde change. They usually disappear in early infancy. However, the septal folds may persist and even hypertrophy and form tumor-like obstructing masses in the adult.

Fig. 19.—A straight septum and nasal cavities of equal size.

ANATOMY.

The septum of the nose is composed of bone and cartilage and is made up, above by the perpendicular plate of the ethmoid, anteriorly by the triangular cartilage, below anteriorly by the maxillary spine, and posteriorly by the vomer.

THE PERPENDICULAR PLATE OF THE ETHMOID.

The perpendicular plate of the ethmoid is an extremely thin bone which descends from the under surface of the cribriform plate. It is much thinner in the middle than at the circumference. Its anterior border articulates with the frontal spine and the crest of the nasal bones. Its posterior, divided into two parts, is connected by its upper half with the rostrum of the sphenoid, by its lower half with the vomer. The inferior border is grooved and serves for the attachment of the triangular cartilage of the nose. Its lower, posterior border is grooved and together with a like groove in the vomer, forms a canal which contains the cartilaginous process from the triangular cartilage. On each side of the perpendicular plate are numerous grooves and canals leading from the foramina in the cribriform plate, to lodge filaments of the olfactory nerves.

THE TRIANGULAR CARTILAGE.

The cartilage of the septum is somewhat triangular in form, thicker at its margins than at its center, and occupies about a third of the total area

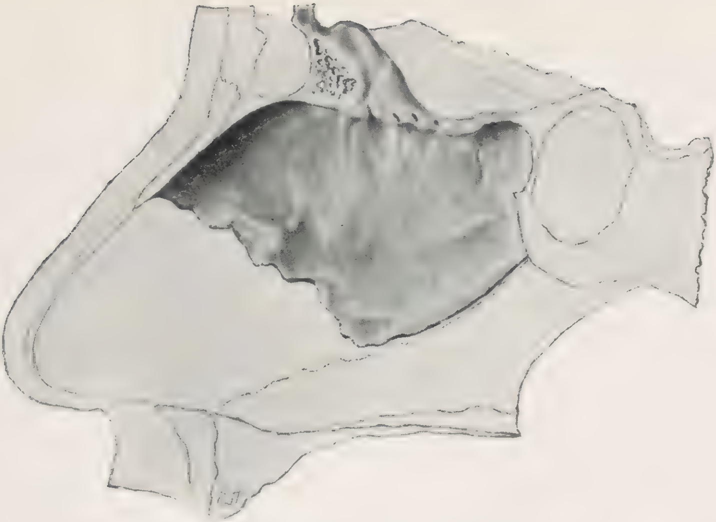

Fig. 20.—Perpendicular plate of the ethmoid.

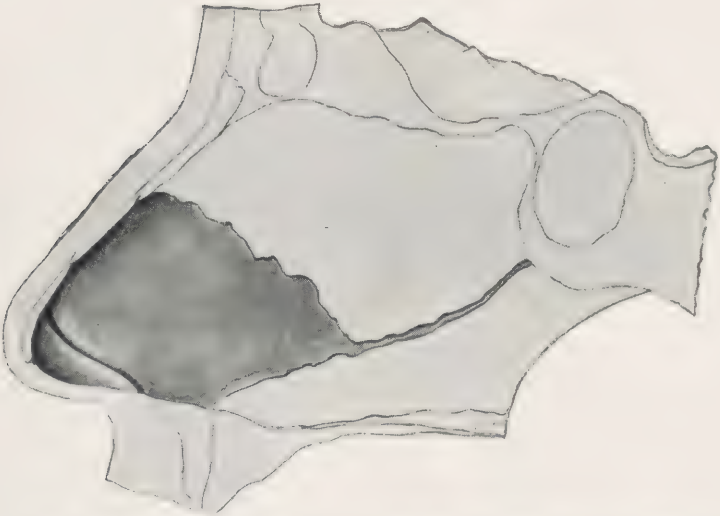

Fig. 21.—Triangular cartilage and tail-like projection of cartilage backward toward the body of the sphenoid.

of the nasal septum. Its anterior margin, thickest above, is connected from above downwards with the nasal bones, the front part of the two upper lateral cartilages, and the inner portion of the two lower lateral cartilages. Its posterior margin sets into the groove in the edge of the perpendicular plate of the ethmoid. Its inferior margin into a similar groove in the vomer and the maxillary spine. The triangular cartilage sends a tail-like projection backwards to the body of the sphenoid through the grooved canal formed by the articulations of the perpendicular plate of the ethmoid with the vomer.

THE MAXILLARY SPINE.

The maxillary spine is a prominent, thick, bony spine about three-eighths of an inch long and one-eighth of an inch thick at the anterior end of the septal crest of the superior maxillary bone. It is rough, very irregular, and presents a sharp edge in front, while above it is grooved for the reception of the triangular cartilage and behind it articulates with the vomer.

THE VOMER.

The vomer is thin, somewhat quadrilateral in shape, and forms the posterior and lower part of the nasal septum. The superior border is the thickest and articulates with the rostrum of the sphenoid by a deep furrow. The inferior border

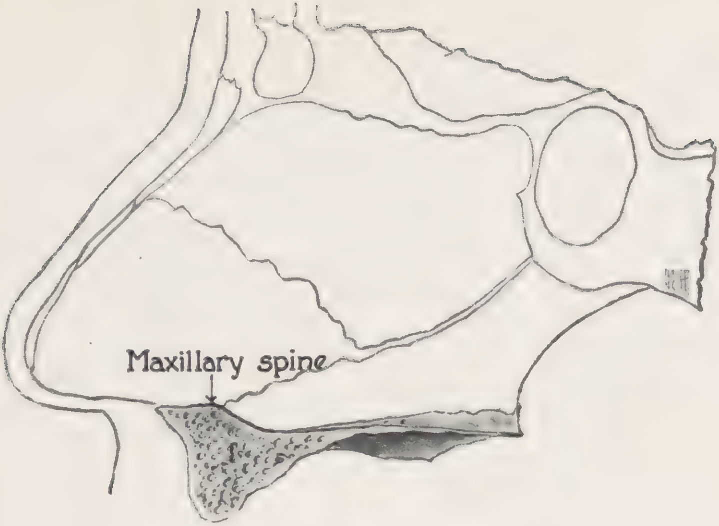

Fig. 22.—Maxillary spine.

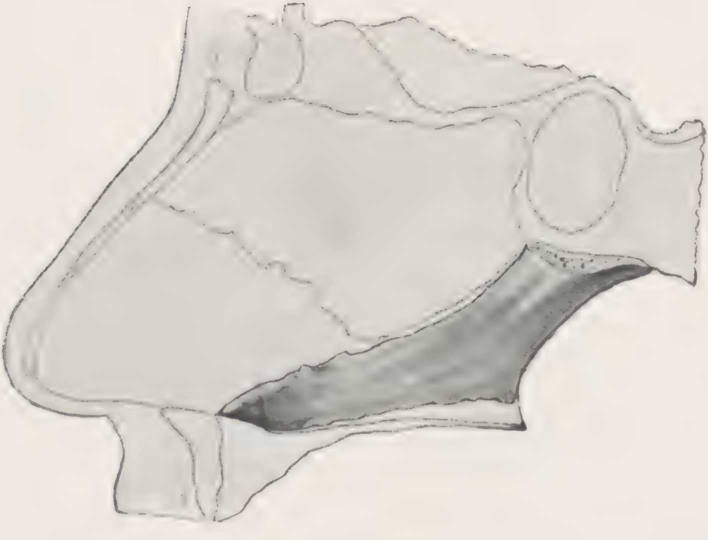

Fig. 23.—Vomer.

articulates with the crest formed by the maxilla and palatine bones. The anterior border is the longest and slopes downward and forward The upper half articulates by a groove, containing the cartilaginous projection from the triangular cartilage, with the perpendicular plate of the ethmoid, and the lower half is grooved for the margin of the triangular cartilage. Its posterior border is free, concave, and separates the posterior nares. It is thick and bifid above, where it articulates with the sphenoid, and is thin below.

BLOOD SUPPLY.

The entire nasal septum is covered, on both sides, by mucous membrane and has an abundant blood supply. The upper part of the septum is supplied by the nasal branch of the ophthalmic artery. The lower and anterior part by the septal branch of the labial. The anterior part is further supplied by a small artery from the facial. The main arterial blood supply arises from the septal branch of the spheno-palatine, and supplies most of the surface of the septum.

NERVES.

The upper and anterior part of the septum is supplied by the nasal branch of the ophthalmic; the upper and back part by the Vidian nerve, and the upper anterior nasal branches from the spheno-pala-

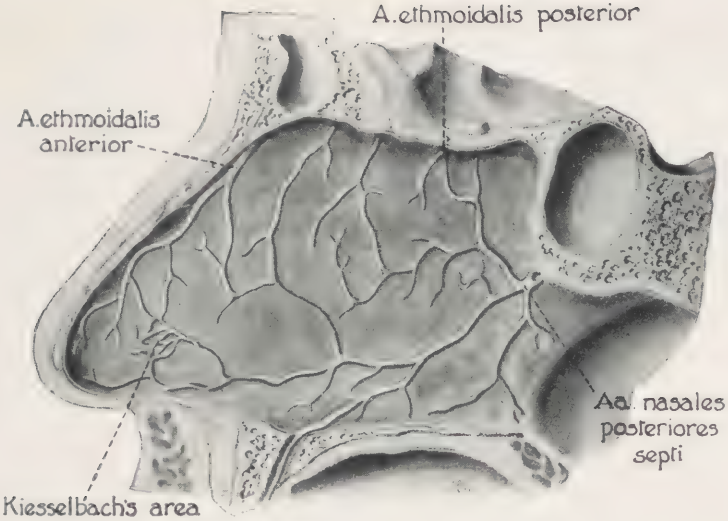

Fig. 24.—Blood supply.

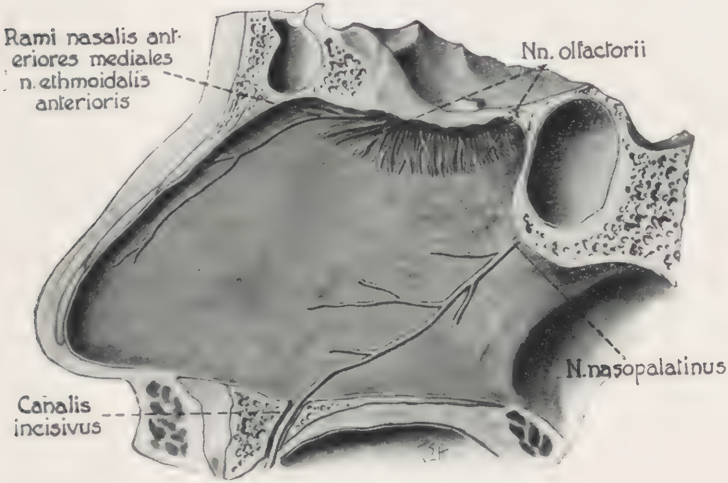

Fig. 25.—Nerves.

tine ganglion, and the middle by the naso-palatine nerve.

DEFORMITIES OF THE NASAL SEPTUM.

The cause of deflected septa, in most cases, is unknown but can be classed under two great heads: First, changes in the septum during its development; and second, traumatism. At an early period, the vomer consists of two separate laminæ, enclosing between them a plate of cartilage. Ossification starts in these two plates about the sixth or eighth week of fetal life, but is not complete until after puberty. About the third year, the two plates begin to coalesce from behind forwards. It will therefore be understood that any hypernutrition or any lack of development of one lamina will produce a distortion of the vomer, which will naturally be accentuated in the cartilage. The fact that ossification begins in the posterior part of the septum, and that coalescence takes place from behind forward, would explain why deviations of the posterior part of the septum are almost unknown. Hypernutrition from any cause may lead to a vertical or horizontal overgrowth. In this way, spurs and ridges may occur from overgrowth, especially along the sutures between the vomer and the cartilage, and the vomer and the perpendicular plate of the ethmoid.

Fig. 26.—Some of the different deflections and thickenings in a septum.

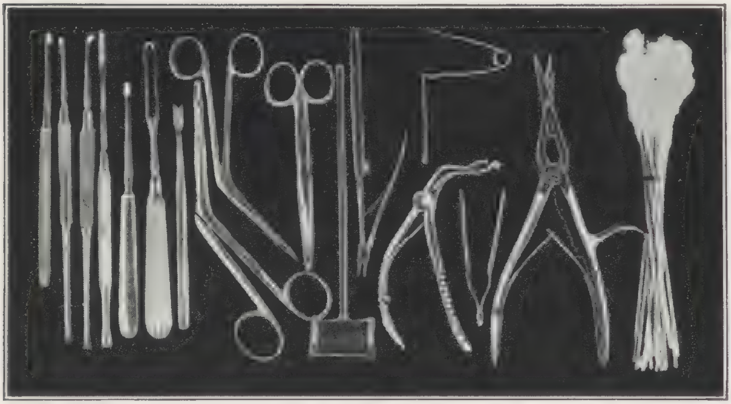

Fig. 27.—Instruments. 1. Freer original septum knife. 2. Small elevator. 3. Freer angular elevator. 4. Long blade elevator. 5. Freer septum knife. 6. Ballenger swivel knife. 7. V-shaped chisel. 8. Duck bill forceps. 9. Small Hartmann forceps. 10. Scissors. 11. Hammer. 12. Needle holder. 13. Monosmith speculum. 14. Allen self-retaining speculum. 15. Foster-Ballenger speculum. 16. Jansen-Struyker forceps. 17. Cotton swab applicators.

ADENOIDS.

Adenoids, by occluding the posterior nasal opening, produce a high arching of the hard palate, which encroaches on the space of the nasal chambers and causes the thin and pliable septum to grow twisted.

TRAUMATISM.

Probably the most frequent cause of deflections in the septum is traumatism. Children, when small and learning to walk, have frequent falls. At this age, the tissues of the nose are soft and pliable and many times the nose must be flattened by these falls. The external nose more or less readjusts itself but the septum, being bent or broken, fails to recover. The weakest place in the septum is along the sutures. Spurs and ridges may be caused by deposits of bone or cartilage thrown out by nature to strengthen the parts that have been broken and later fail to be absorbed when the parts have healed. Injuries occurring later in life are more apt to cause deflections in the cartilage, ossification having been more or less completed in the vomer and the perpendicular plate of the ethmoid, these bones showing more resistance to traumatism. Later on unequal air currents, colds and other irritants cause changes in the mucous membrane covering the septum and the turbinates, when nature tries to readjust the air spacing. Deflections in the septum cannot be classi-

Fig. 28.—Patient in semi-reclining position.

fied, there being so many kinds and varieties, furthermore, a classification would be of no benefit as a complete submucous resection should be performed in every case.

Spurs and sharp deflections occur along the sutures between the vomer and the triangular cartilage, and between the vomer and the perpendicular plate of the ethmoid. An apparently straight septum may be unusually thick, due probably to traumatism, the septum being broken by the injury but returned to its straight line, and the resultant inflammation thickened the tissues which did not return to normal thinness. A deflected or thickened septum is probably the beginning of nearly all the troubles within the nose. As soon as a deflection occurs, nature at once begins to readjust the nasal cavities to equalize the air currents passing through, with the resultant compensatory hypertrophy on the concave side and compensatory atrophy on the convex side. From this time on infections, congestions and irritations are responsible for the inflammatory changes. If, therefore, the septum is the primary cause of nearly all the changes within the nasal chambers it should have first consideration. If we go back to the function of the nose, we find that a submucous resection restores the nasal cavities as near as possible to their equal size with the least amount of damage to the mucous membrane. Nature then, if given time, will restore the

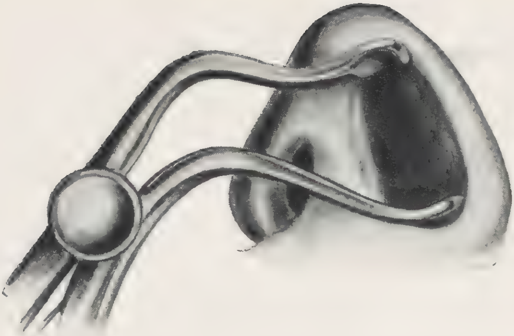

Fig. 29.—Monosmith nasal speculum opening the nostril.

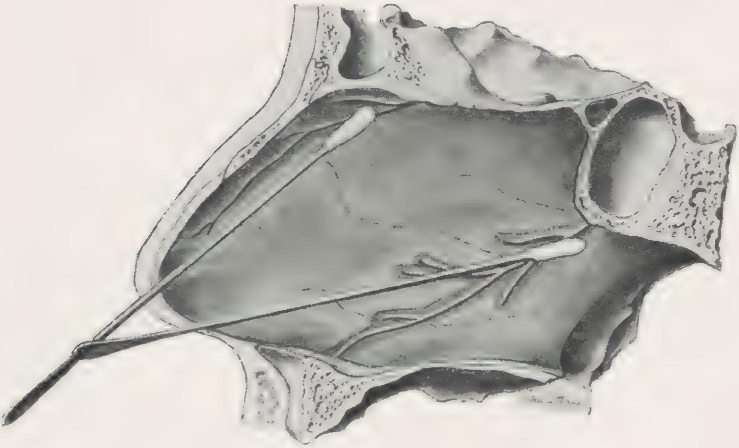

Fig. 30.—Cotton wound applicators in position on nerves for anesthesia. One lies just anterior to the anterior end of the middle turbinate, the other just under the posterior end of the middle turbinate.

turbinates and the mucous membrane to their normal condition.

SUBMUCOUS RESECTION.

The patient is operated on in the semi-reclining position. He is then comfortable, does not faint, you have better control of his head, and the operator is working with his arms down in a natural position.

Nature has wisely provided a coating to the mucous membrane of the nose which has an inhibitory action to the growth of bacteria of the air; therefore, it is better to do very little cleaning of the membranes before a submucous resection for fear of washing off this protection. The outside of the nose is cleansed with alcohol and the face is covered with a piece of gauze moistened in 1:5000 mercuric chlorid solution. The hairs in the vestibule are clipped to give a better view of the inside of the nose, and this area is wiped with iodin followed by alcohol. Nearly all the germs entering the nose are lodged in the vestibule. Both sides are sprayed with a little cocain, (four per cent.), and the nerves blocked by the following method: The ends of four wooden applicators are slightly notched to prevent slipping and wound with a small piece of cotton. The cotton is then moistened with epinephrin, (1:1000), and applied to flaked cocain until it becomes saturated.

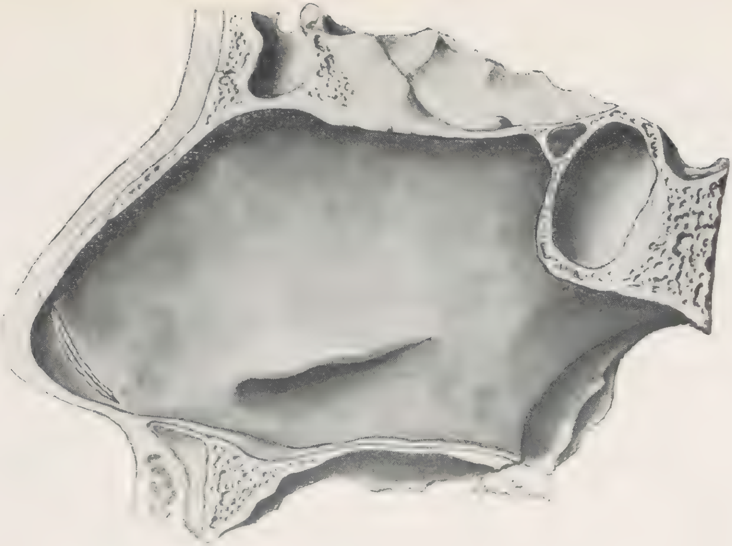

Fig. 31.—Original incision. The ridge on the septum represents a spur.

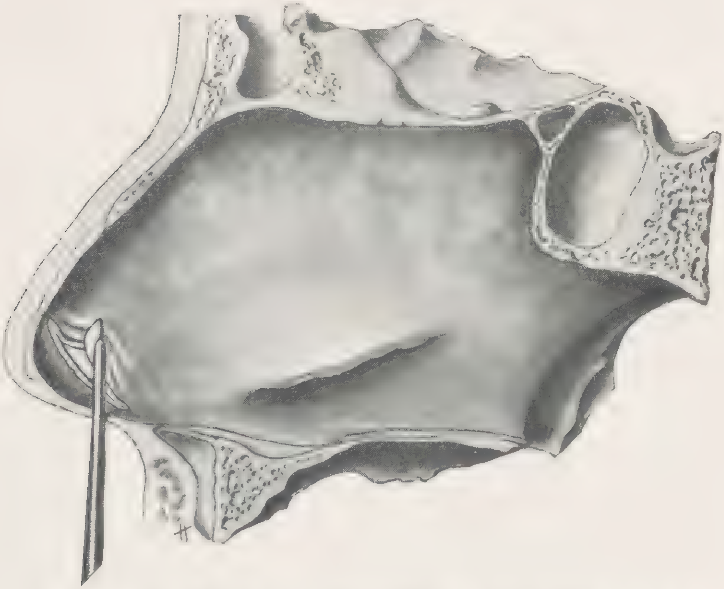

Fig. 32.—Pushing back the membrane with the edge of knife to expose cartilage at center of the cut.

One applicator is placed as high up as possible on a line with the anterior end of the middle turbinate, which blocks the anterior nasal nerve; another is placed at the posterior end of the middle turbinate and blocks the nerves from the spheno-palatine ganglion. This is repeated on the other side, as it is necessary to block the nerves on both sides of the septum.

A flat piece of cotton, saturated with epinephrin, (1 : 1000) is placed against the septum on each side to help to prevent bleeding during the operation. The patient is then given a hypodermic of one eighth grain of morphin and one- two hundred and fiftieth grain of atropin. This small dose does not make the patient "dopey," but it is large enough to cause relaxation and to take away fear; it also helps to prevent the after bone pain when the cocain wears out. In about twenty minutes, the cotton and applicators are removed and the operation is performed without pain and, in most cases, with very little bleeding.

The nostril is held open with a Monosmith or right angle nasal speculum. The cut is made with a Freer septum knife on the convex side of the deflection; you are thus able as you elevate the membrane to lift out the flap and so get around the bend without tearing it.

The incision is made in the mucous membrane at its junction with the skin, extending from the

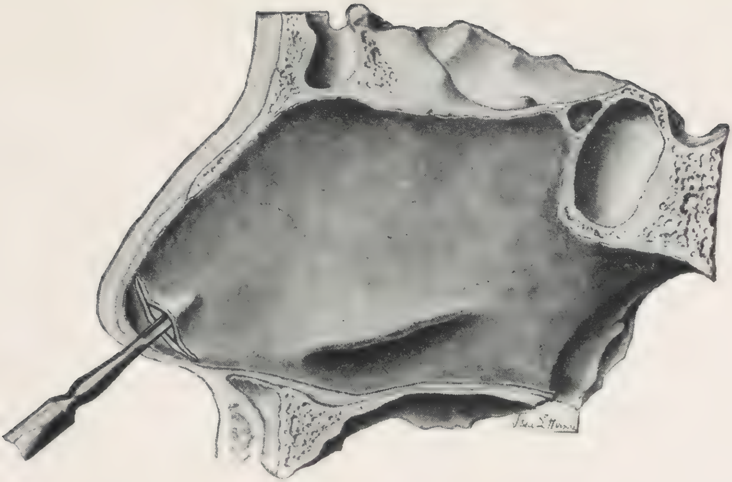

Fig. 33.—Elevating center of cut with small elevator.

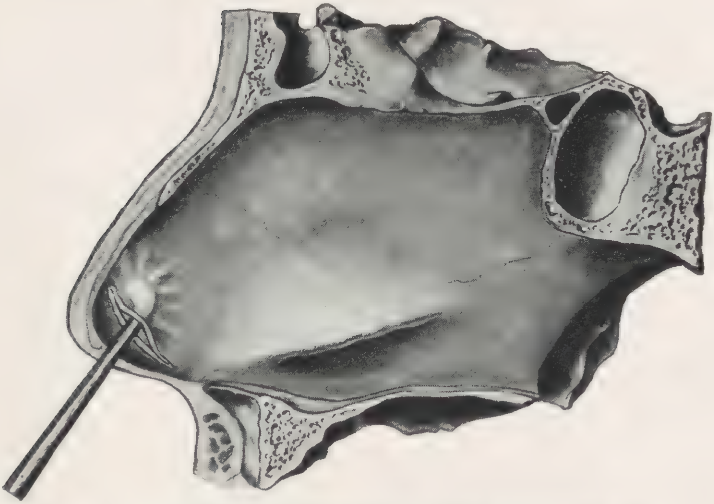

Fig. 34.—Elevating the membrane at upper part of cut from the inside with angular elevator.

tip of the nose down to but not onto, the floor. When making this incision, one should cut through mucous membrane only, except at the center, where a little pressure is added so that a deeper cut is made through the mucous membrane and perichondrium to the cartilage. The membrane is then pushed back at the center of the cut with the edge of the knife until the white, shining cartilage shows. It is then raised for a short distance with a small elevator. The membrane raises easily if the elevator is between the perichondrium and the cartilage, and raises with difficulty if between the perichondrium and the mucous membrane.

The angular elevator is now introduced, and the membrane separated from within outward toward the cut, both above and below the original elevation. The original incision is now completed with the knife through the length of the membrane, cutting from the inside out, both above and below. The danger of penetrating the cartilage and the mucous membrane of the other side is lessened by cutting to the cartilage at the center only, and completing the incision from within out, rather than making the original cut extend to the cartilage through its entire length.

The membrane is now raised with a long blade elevator as far back and as low down as possible, or, if there is a spur, down to its sharp edge. The original cut is now extended down onto the

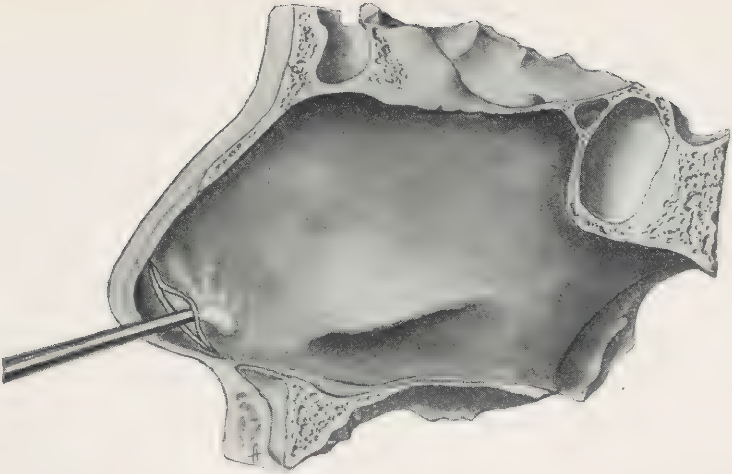

Fig. 35.—Elevating the membrane at lower part of cut from the inside with angular elevator.

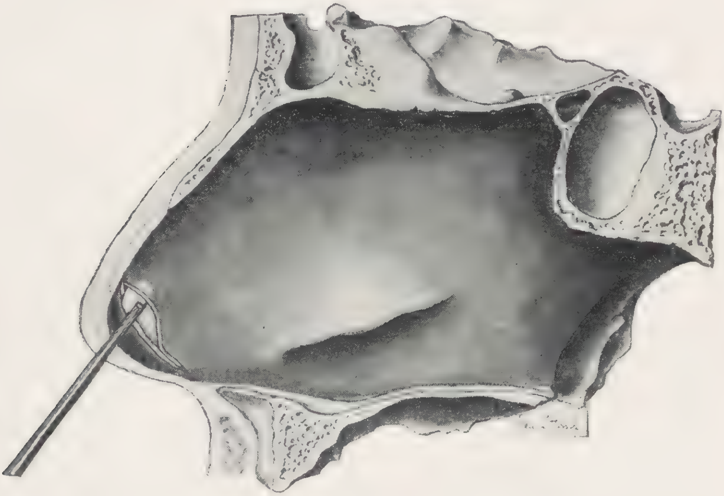

Fig. 36.—Completing cut above with the Freer knife from the inside out.

floor; bleeding comes with this cut, and so it is made after most of the membrane is raised, to have a field clear of blood while starting the elevation.

The membrane on the floor is then elevated with the small elevator; it starts with some difficulty as the skin extends in onto the floor and is bound tightly to the bone at this point. After the membrane on the floor is elevated, the membrane on the septum is raised from below up to meet the elevation from above, or, if a spur is present, to elevate the under side up to and freeing its sharp edge.

In many cases it will be necessary to use a knife to cut the strong adhesions between the membrane and the bony septum along the sutures between the vomer and the triangular cartilage and the vomer and perpendicular plate of the ethmoid, as the fibers of the perichondrium and the periosteum cross from one side of the septum to the other along the suture.

After the membrane is completely raised, it extends from the top of the nose out onto the floor like the side of a tent.

The cartilage is incised with a Freer septum knife just inside the original cut at an oblique angle, which brings you through at a slant just under the perichondrium on the other side. As much of the mucous membrane as possible is then raised on this side, being sure to elevate well down on the floor in front, with the angular elevator. As this

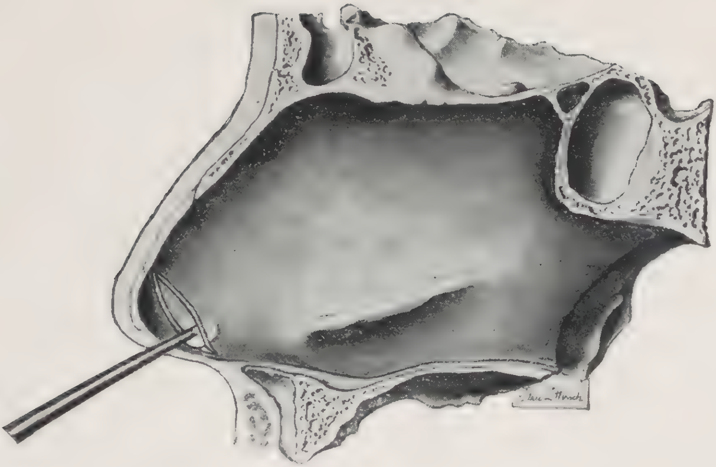

Fig. 37.—Completing cut below with the Freer knife from the inside out.

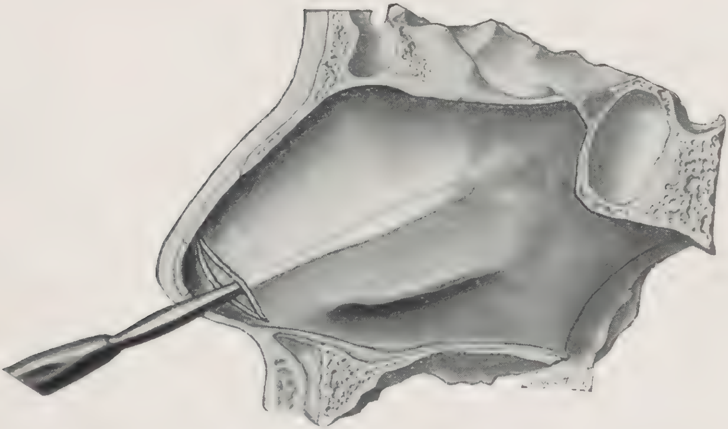

Fig. 38.—Elevating the membrane back and down to the edge of spur, with the long blade elevator.

is the place where the chisel will enter later, it is necessary to have the membrane well elevated at this point to prevent tearing.

The Foster-Ballenger speculum is now inserted and holds the flaps of mucous membrane away from the cartilage and bony septum. The flaps are then inspected to see if they are entirely free on both sides.

After the flaps are elevated, a small slice about one-eighth of an inch wide is taken off of the cartilage along the inner edge of the cut. This is to prevent exposure of the cartilage if the flaps retract in healing. To avoid the dropping of the cartilaginous bridge and give it support, leave in place as large a piece of the triangular cartilage as possible, the thickness and deflection determining the size. A nick is made in the triangular cartilage with the scissors as low down as necessary to retain the piece desired. The Ballenger swivel knife, starting in this cut, is carried in and up with a half curve, then in, then down, and then out, following the cartilaginous bony union. This cut piece of cartilage is now removed. The piece of cartilage left, is easily pushed over by the Foster-Ballenger speculum against the opposite flap, there to remain until the operation is completed. After the cartilage has been pushed over, you have a better view of the inside and then can see if the flaps are fully free. Before closing the flaps, if this piece of car-

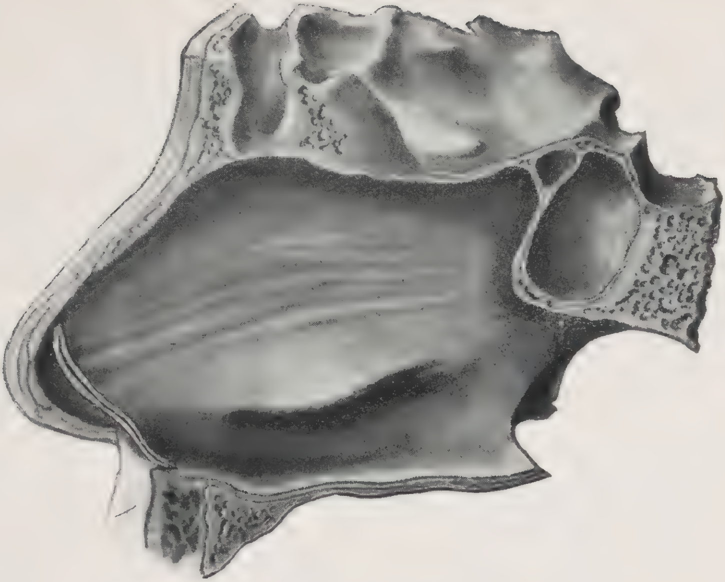

Fig. 39.—Extending original cut down on the floor.

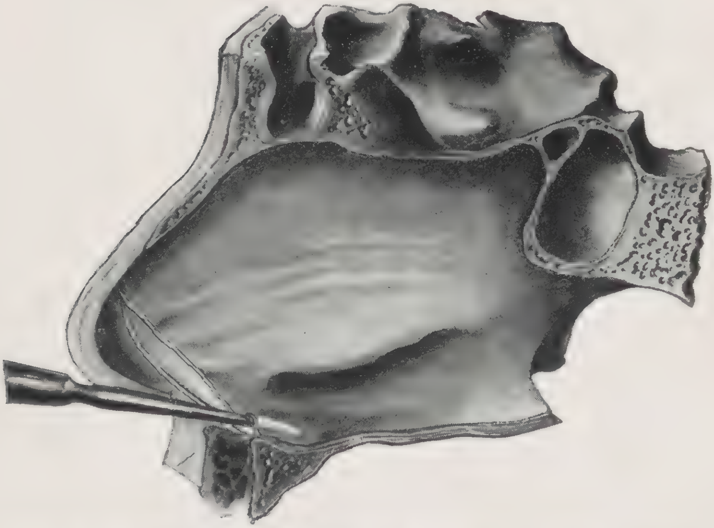

Fig. 40.—Elevating the membrane on the floor with small elevator.

tilage causes a tent, start in the deeper part of the nose and cut this piece toward the tip of the nose until it hangs straight, never entirely cutting it off. This piece of cartilage between the flaps gives support where it is most needed, and helps prevent the flapping of the septal membrane when the nose is blown.

With the Jansen-Struyker forceps, bites are made in the bony septum high up under the ridge and along the suture between the vomer and perpendicular plate of the ethmoid; then with a pair of duck bill forceps, this piece of bony septum is broken out. These bites should always be made; they not only allow the piece of bone between the cuts to be easily removed but most important, prevent the possible fracture of the cribriform plate, which might happen if only the duck bill forceps was used to break out this part of the bony septum. Duck bill forceps is then used to break out the remainder of the perpendicular plate of the ethmoid back to the sphenoid; being sure the bone is well removed between the middle turbinates, this being the most important region in the nose.

We have now remaining the vomer (so-called crest). Along its upper edge is a strip of thick cartilage. This strip is the remains of the triangular cartilage, the cartilaginous edge of a spur, or the strip of cartilage between the perpendicular plate of the ethmoid and the vomer, which is re-

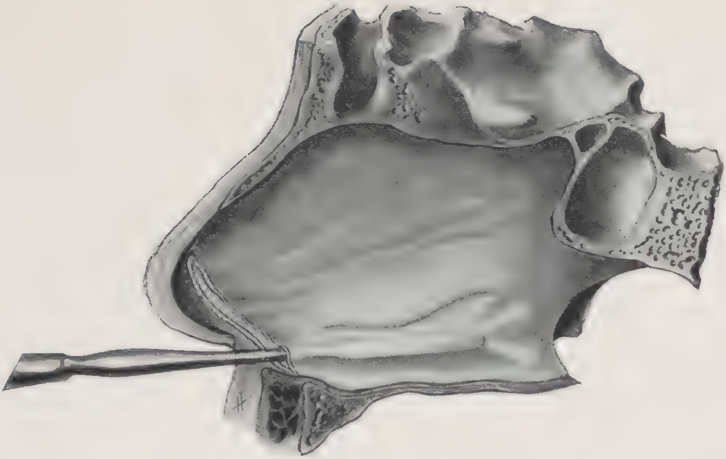

Fig. 41.—Elevating the membrane on under side of the spur after the membrane on the floor has been raised.

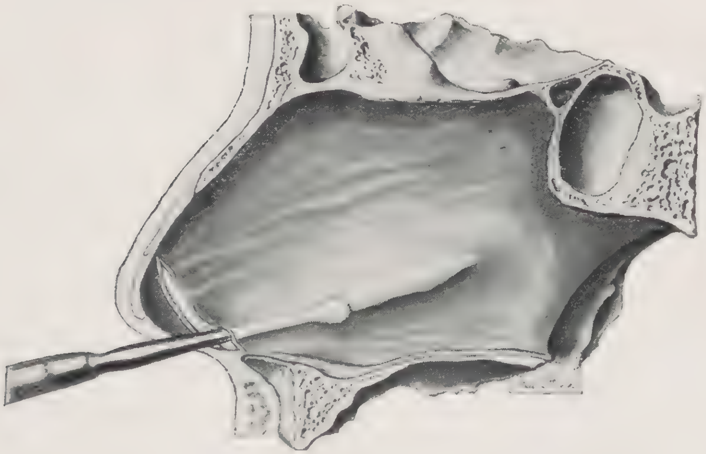

Fig. 42.—Cutting the fibers of the perichondrium and periosteum along the suture.

moved with the angular elevator; if necessary, now finish elevating the membrane on the other side of the vomer by starting the right angle elevator deep in the nose and drawing it toward the tip between the bone and the periosteum. The flaps now being free, a V-shaped chisel is placed on the maxillary spine and with one or two sharp taps of a hammer,

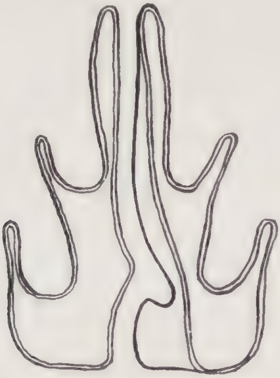

Fig. 43.—The membrane raised from above down onto the floor like the side of a tent.

this spine, together with the anterior part of the vomer, is broken off. If it is impossible to elevate the membrane on the opposite side, because of a spur with a sharp overhang, fracture the vomer with the V-shaped chisel and carefully rotate the piece of bone free from the membrane. In this way it can be removed without a tear. The rest of the vomer is then removed, either with the chisel or the duck bill forceps.

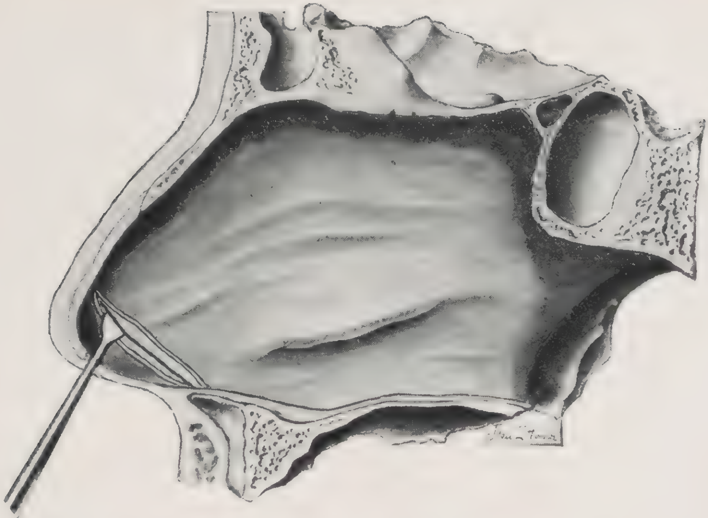

Fig. 44.—Incising the cartilage with the Freer septum knife.

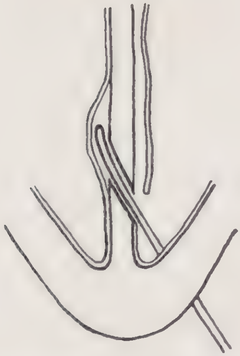

Fig. 45.—The angle at which the septum knife cuts through the cartilage.

The inside of the flaps are swabbed with mercuric chlorid (1:5000) and thoroughly dried out to prevent infection. The speculum is now removed, the flaps are brought together and inspected to see if they hang straight and that no ridges or spurs are left.

One suture is used to close the incision and to prevent the membrane from retracting and so minimize the width of the scar. Insert an Allen self-retaining speculum, hold the inner flap with a pair of small Hartmann forceps, and pass a small eye needle carrying a silk suture through the edge of it; then pass the needle in the opposite direction through the edge of the outer flap. The suture is then tied, bringing the edges of the flaps together. This is an easy suture to place. It makes a figure eight of the tie but holds the flaps until healing takes place. In a few days it is removed.

The septum and the turbinates on both sides of the nose are swabbed with 1:5000 mercuric chlorid to prevent infection.

Plates of dental wax, as wide and as long as possible, are placed on each side of the septum to support the membrane. These remain two days to prevent the patient from blowing the nose and disturbing the flaps. No other packing will be necessary.

After Treatment.—After the wax is removed, the nose is cleansed and the patient instructed to use

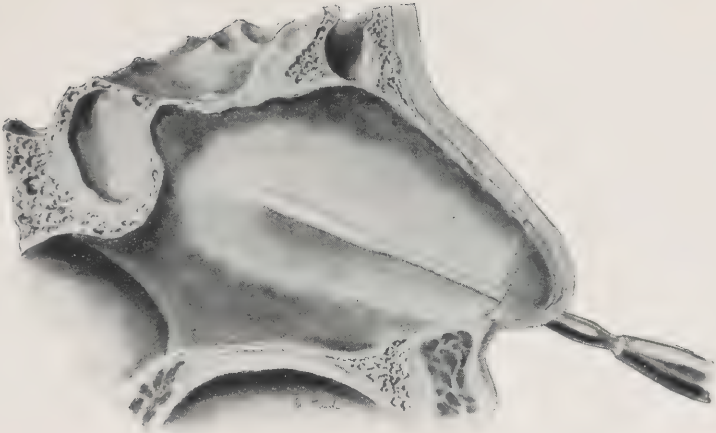

Fig. 46.—Long blade elevator elevating the membrane on the opposite side through the cut made by the septum knife.

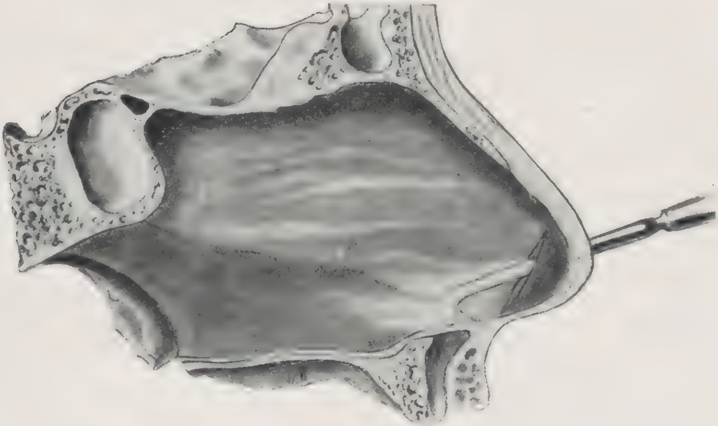

Fig. 47.—Elevating the membrane on the opposite side well down in front with the angular elevator.

a nasal oil two or three times a day until the septum and turbinates re-adjust themselves.

The patient should also be instructed as to the method of hawking and blowing his nose.

The nasal chambers are so constructed that secretions tend to flow towards the posterior nares. The floor slants back and the cilia of the mucous membrane wave toward the posterior opening.

The natural method of removing the secretions from the nose then is "hawking" back. There is no tension on the membranous septum when doing this and no danger to the ears.

"Hawking" cannot be done in public but the patient has an opportunity two or three times a day to clear his nose by this method.

In blowing the nose, care should be taken always to blow with both nostrils free. If the nose is blown so that more air passes through one side than the other, the membranous septum is "ballooned" out on one side. This stretches the membrane, and in time makes it very lax, besides the danger of blowing nasal secretions into the ears.

Holding one side of the nose closed while blowing through the other side also "balloons" out the membranes and is a bad practice.

COMPLICATIONS.

Tenting of Septal Membrane.—A complete submucous resection should be performed in every case.

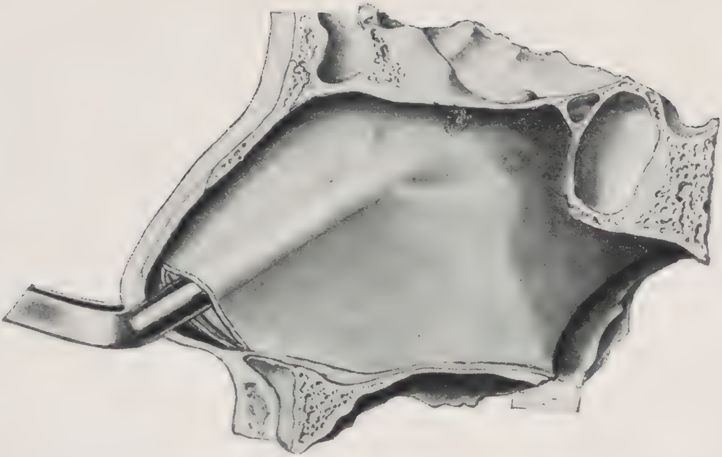

Fig. 48.—Foster-Ballenger speculum in place to hold the flaps away from the cartilage and bony septum.

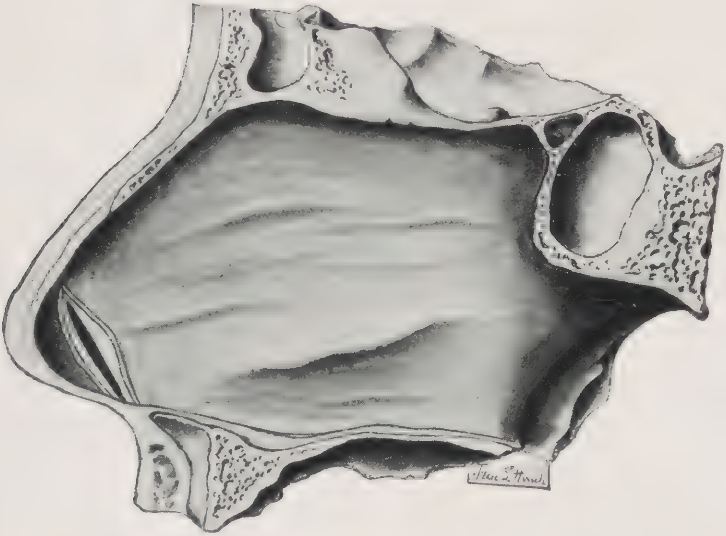

Fig. 49.—A small slice of cartilage has been removed from the inner edge of the cut.

Septums which are apparently straight will be found after the mucous membrane has been elevated to be quite deflected especially in the region of the vomer.

After the cartilage and bone has been removed and before the flaps have been sutured, the septal membrane should be inspected carefully to see that there is no tenting either above or below.

Enough bone will have to be taken out above to allow the membrane to hang straight and enough of the vomer to prevent tenting below, otherwise the object of the operation has been defeated.

Tenting either above or below has been the cause of more failures to get results from a submucous operation than any other thing.

Perforations.—If, after the operation is completed and you find you have a tear through both flaps, not too large a hole can be closed by the following method: A cut is made through the larger flap as high up as possible and extending as long as necessary to allow this flap to drop or fold down, covering the tear in the other flap. If you use the flap with the original cut you must leave it attached in front, and must have as much membrane as possible over the tear; just barely covering it will not do, as mucous membrane flaps always retract.

Nearly all the perforations during a submucous resection are due to sharp angular spurs, which

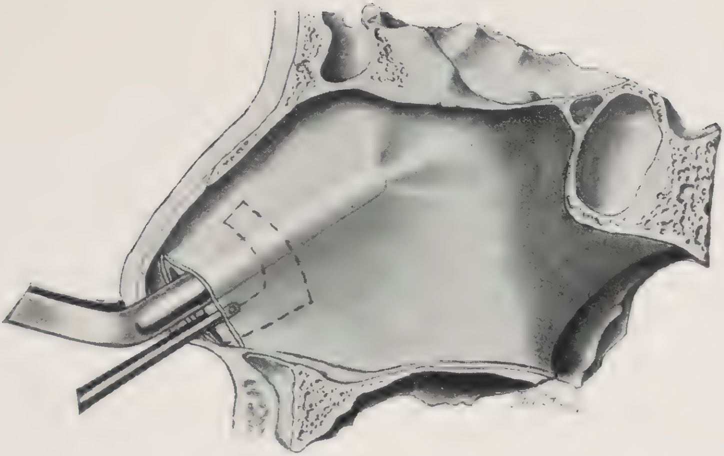

Fig. 50.—The direction the Ballenger swivel knife takes to remove as little cartilage as possible.

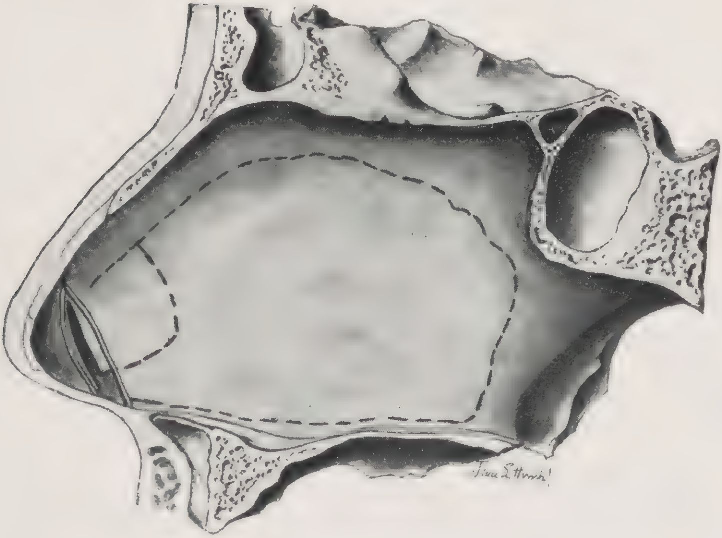

Fig. 51.—Cut made if necessary in the piece of cartilage left to make it hang straight.

occur most frequently along the suture between the triangular cartilage and the vomer and the perpendicular plate of the ethmoid and the vomer. This is opposite the lower turbinate and if you are unable to close the perforation by the flap method, scarify the larger turbinate opposite the tear and pack the septum over against it. A plate of dental wax is placed against the septum on the opposite side, the packing outside of this; the wax allows

Fig. 52.—Drawing to show how cut in cartilage makes it hang straight.

the packing to be changed every other day without disturbing the wound. In about a week, the septum and turbinate will become adherent, and as soon as the adhesion is firm, the adherent piece of the mucous membrane of the turbinate is cut out, closing the hole.

In cases of old perforations following a submucous resection, the technic is the same, except that you must also scarify the edges of the hole, and, if necessary, the turbinal attachment can be fractured and the turbinate brought out to meet the septum.

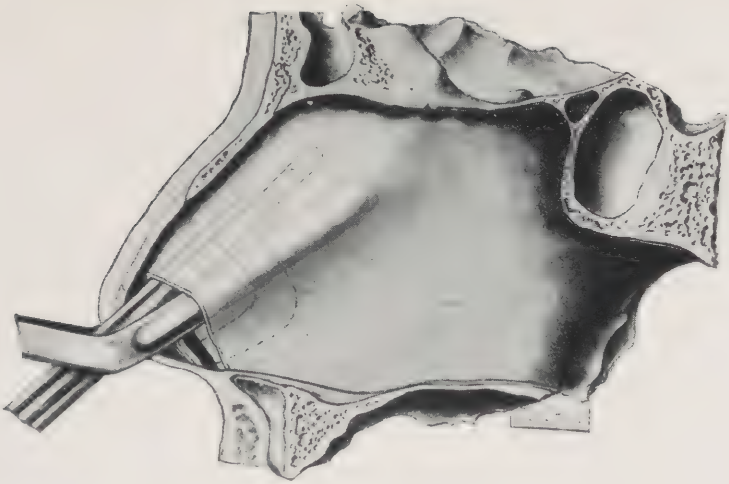

Fig. 53.—Cuts made by the Jansen-Struyker forceps up under the ridge.

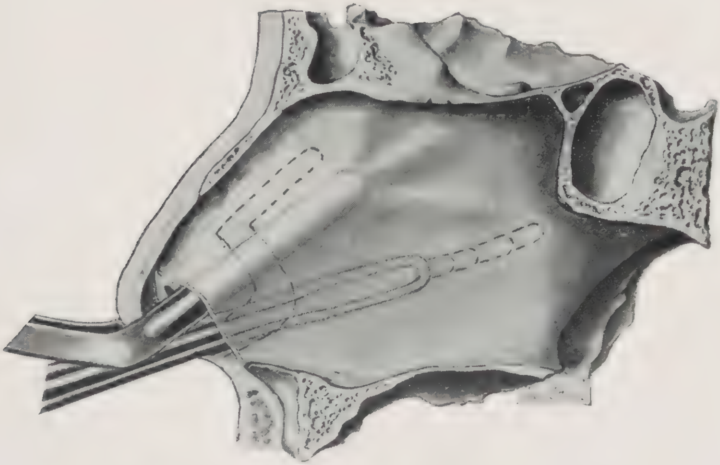

Fig. 54.—Cuts made by the Jansen-Struyker forceps along the upper suture of the vomer.

If the turbinate is not directly opposite the perforation, the turbinate can be almost entirely detached and brought up to reach the hole. After it has become adherent to the septum and the perforation closed, it is returned to its original position where it will again attach itself.

The turbinates have such an abundant blood supply that they will attach themselves to most any denuded surface, provided a small part of the original attachment is left to supply the blood until the new attachment becomes fixed.

Scarlet Red.—After completing the operation, tears in the mucous membrane and thin spots from ulceration are smeared with an ointment of scarlet red (10 per cent.); these areas heal nicer under this treatment.

Hyperplasias.—Soft anterior ends of the middle turbinates and the soft hyperplasias on the posterior ends of the lower turbinates can be removed at the completion of the submucous operation; also any polypi coming from the ethmoids.

The middle turbinates are to be broken over to give better drainage if the patient is having congestive sinus trouble.

Hematoma.—If a hematoma forms between the flaps, it will be necessary to cut the flap at the most dependent portion to let out the blood. They occur in the lower part of the septum either at the extreme anterior or extreme posterior part and

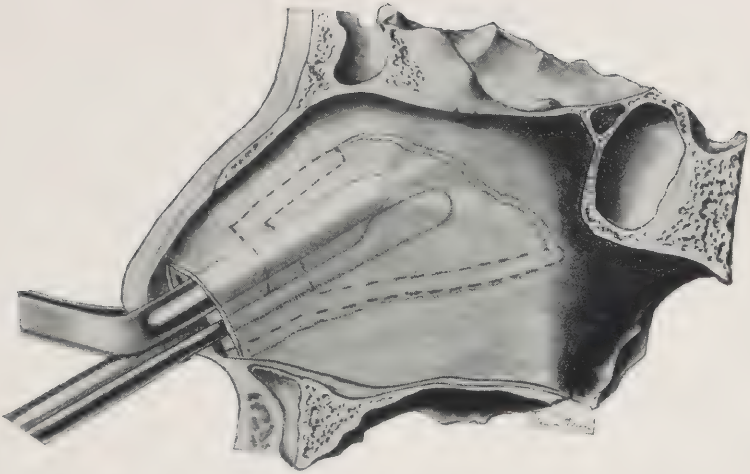

Fig. 55.—Piece of bone broken out between the cuts made by the Jansen-Struyker forceps by the duck bill forceps.

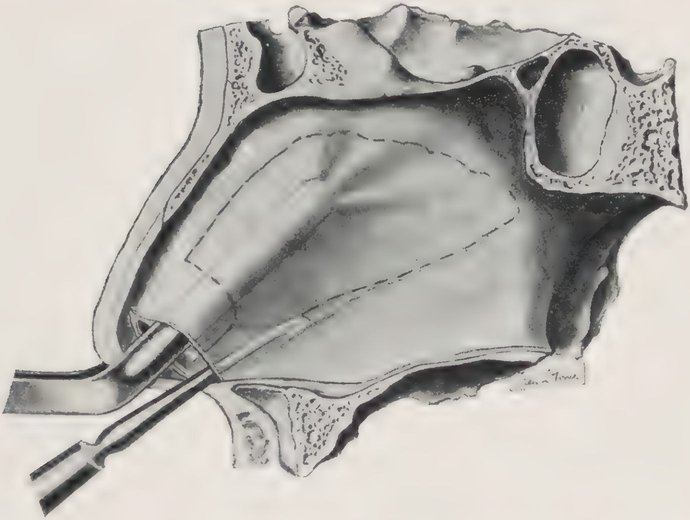

Fig. 56.—Angular elevator removing the strip of cartilage along the upper edge of the vomer.

cause occlusions of the nasal chambers. They are due to excessive bleeding from the bony septum or to slow clotting time of the blood.

Cartilage Slough.—Occasionally the piece of cartilage left will slough, the original cut can be reopened to let out this soft material. It is thick and pearly white in color and not yellow in color like pus.

Abscess.—If a blood clot between the flaps becomes infected, an abscess forms and should be opened early in its most dependent portion, and the cavity washed out with a normal saline solution. A small drain should be used to keep the cavity draining.

Infections.—Two or three days after the operation, if the patient complains of a "stuffiness" in his nose, a headache and generally not feeling well, together with a slight temperature, one should suspect an infection.

In these cases an injection of diphtheria antitoxin (3000 to 5000 units) should be given at once as the patient responds quickly to this treatment. Antitoxin is used because it is easily obtained at any drug store and furnishes the foreign protein which increases the leukocytosis.

The bowels should be opened and large doses of sodium salicylate (15 grains every three or four hours) given, together with steaming the nose.

Fig. 57.—Drawing showing the position of the cartilage when spurs are present. This is cut from the bone by the angular elevator so the membrane can be elevated below the spur.

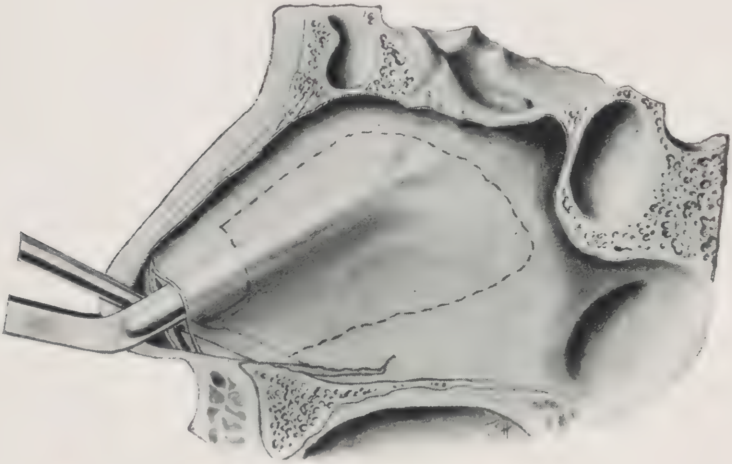

Fig. 58.—The V-shaped chisel on the maxillary spine to fracture the anterior part of the vomer.

The flaps in infected cases are always thick and the patient uncomfortable because of the breathing. Steaming the nose gives the most relief.

Meaty Membrane.—In some cases, a thick meaty membrane forms on the septum and turbinates; it is not diphtheria but a fibrous exudate and responds quickly to an injection of diphtheria antitoxin.

Loss of Sense of Smell.—Occasionally a patient will complain of the loss of sense of smell which will last sometimes a week or ten days even with a perfectly clear nose. The submucous operation can hardly injure the nerves of smell as the highest part of the septum removed only goes to the lower ends of these nerves.

It may be that these cases had a more or less well developed Jacobson's organ which the operation disturbed.

Dry Catarrh.—We have observed a few cases of dry catarrh developing after a submucous resection. The mucous membrane is pale and covered with a thin, sticky secretion. These cases all have some sinus condition and the general constitution is below par. The treatment is outlined under Atrophic Rhinitis.

Septum Hypertrophies.—About a month or two after the operation, if the patient is still unable to breathe easily, the soft hypertrophies on the septum in front of the anterior end of the middle turbinate are to blame. If these are deeply cauterized, a

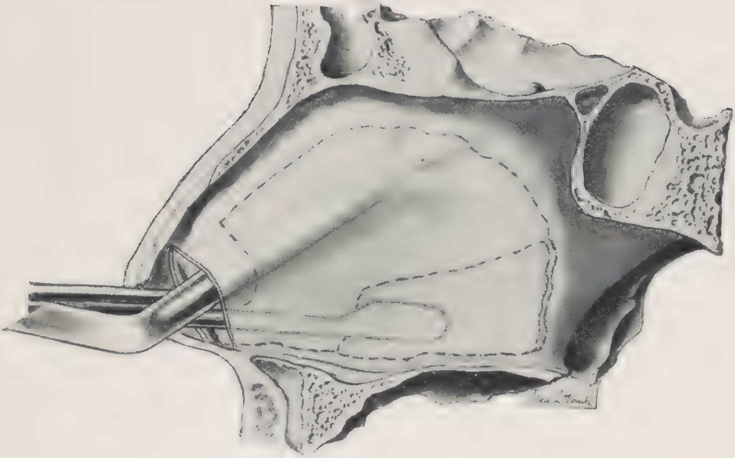

Fig. 59.—Posterior part of the vomer removed with the duck bill forceps.

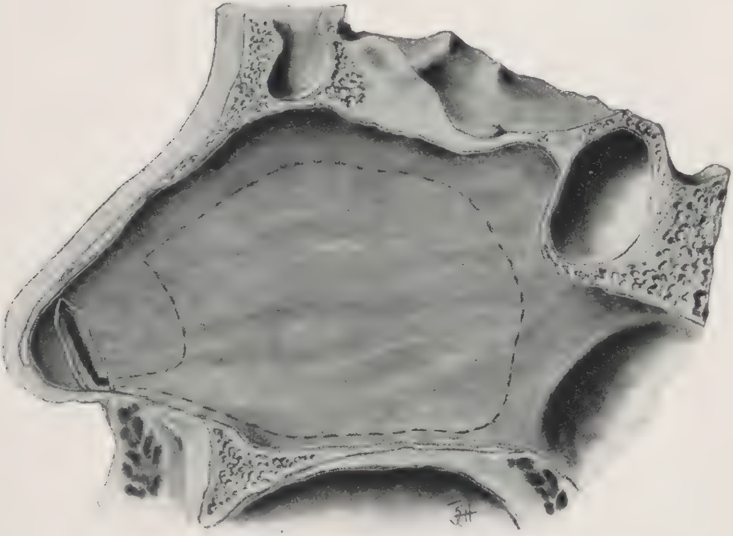

Fig. 60.—Amount of cartilage and bone removed in a complete operation.

roomy nose is the result as soon as the burn heals. Only one side is to be cauterized at a time.

Lax Membranes.—After the cartilage and bone have been removed in a septum operation, the membrane is lax and baggy due to the excess of membrane that was necessary to cover the deflection and the spurs. In a few months, nature shortens this septal membrane and in this way stiffens it.

Bone or cartilage is probably not regenerated although one author has found islands of bone in a septum that had been operated several years before.

After several months, if the membrane is still lax and flutters when breathing, it can be tightened by cauterizing the thickened areas found over the membrane.

Whistles.—A whistle in the nose following a submucous resection is due to a small perforation well forward in the septal membrane. The piece of cartilage left in front of the perforation is curved so that when the nose is blown, the membrane on the one side balloons out and the air is forced through the hole, causing the whistle.

The curved cartilage in front of the perforation should be removed to straighten the membrane or the hole enlarged.

Re-operation.—It may be necessary to re-operate a septum after an incomplete submucous resection has been performed.

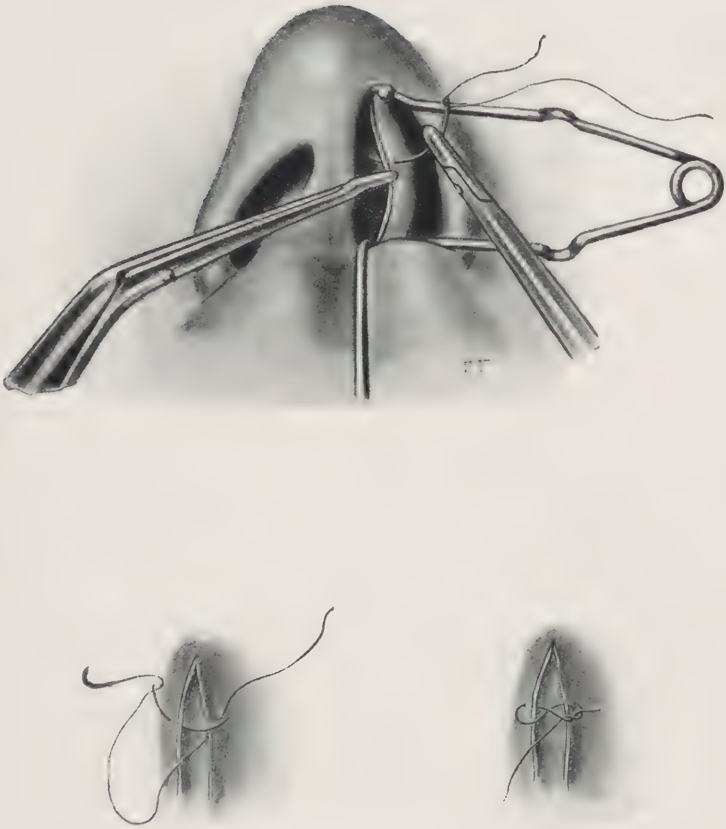

Fig. 61.—Method of placing suture to close the flaps.

Beginners, as a rule, remove only the cartilage while more experienced operators are inclined to leave bone above and below causing tenting of the septal membrane, which defeats the object of the operation.

Membranes between which the cartilage or bone have been removed are almost impossible to separate after they have healed.

The primary incision in the mucous membrane

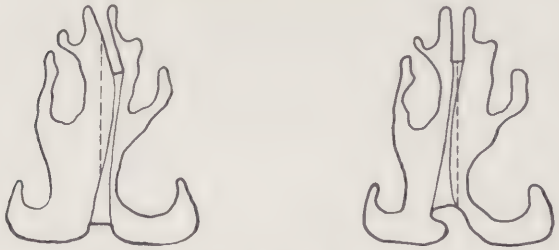

Fig. 62.—Drawing showing tenting from above, also tenting from below in incomplete operations.

in a case for re-operation must be entirely different from one which is operated for the first time. If only the cartilage has been removed, the incision is made along the crest of the vomer as far forward as the original incision should be and then down onto the floor. Raise the membrane off the floor and then up the side of the vomer until the incision is free. With the long elevator raise the membrane over the vomer as far back as possible. With the angular elevator raise the membrane from within forward over the perpendicular plate of the ethmoid

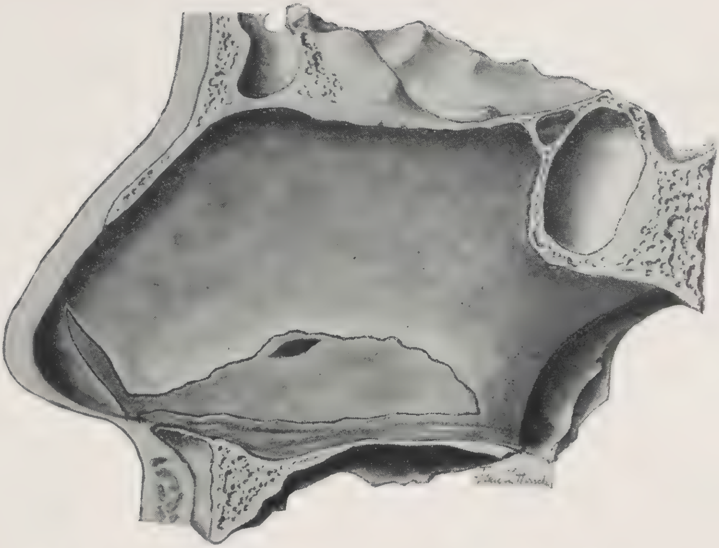

Fig. 63.—Flap on one side torn and a perforation in the other.

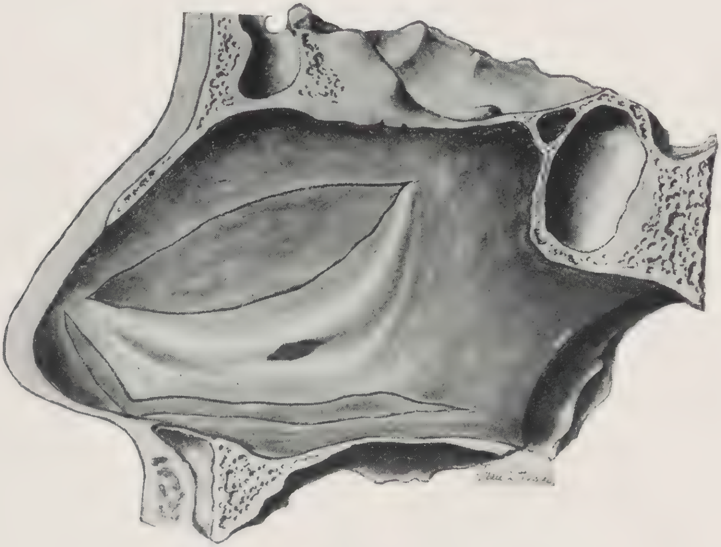

Fig. 64.—Sliding flap to close perforation.

up to the area where the cartilage has been removed. Now extend the original incision around the area where the cartilage was removed as high up as necessary to make the flap free on this side. Return to the original incision along the crest of the vomer and with a sharp knife cut the adhesion along this crest until the angular elevator can be intro-

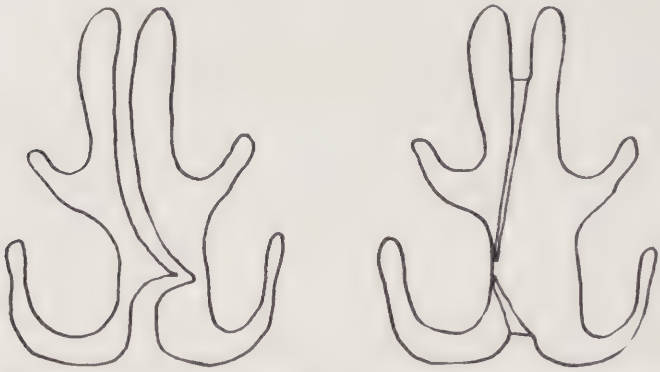

Fig. 65.—Using inferior turbinate to close perforation in septum.

duced between the vomer and the membrane on the other side. This is the most difficult part of the operation as great care must be used not to perforate the membrane of the other side.

The angular elevator can now separate the membrane along the crest both forward and backward around the area where the cartilage was removed and the long elevator used to complete the elevation on this side.

The Foster-Ballenger speculum is introduced and the area where the cartilage was removed is con-

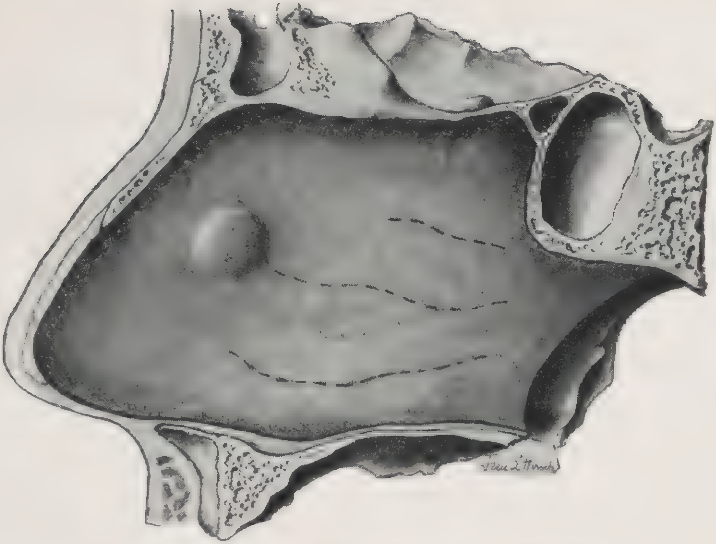

Fig. 66.—Soft hypertrophy on the septum.

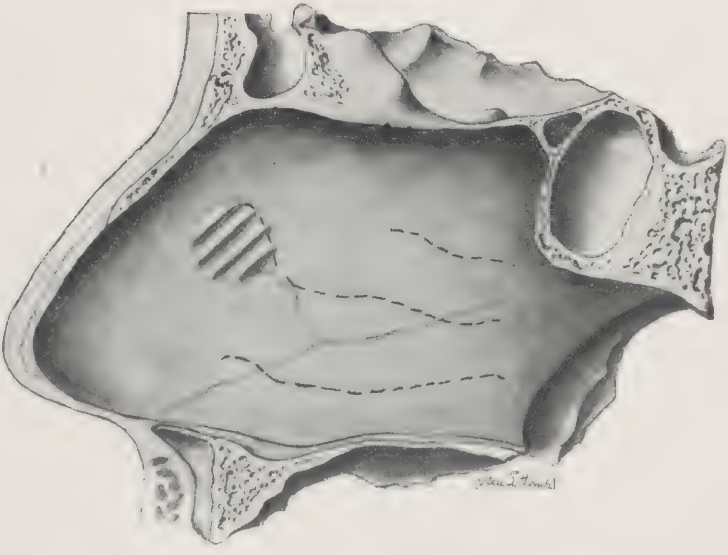

Fig. 67.—Cautery marks in soft hypertrophy.

sidered part of the flap of the opposite side. From here on the operation is the same as the regular submucous.

In re-operating a case with a perforation, the incision is made around the hole and proceeds as a regular submucous.

In operating a case for the first time with a perforation, proceed as with a regular submucous, disregarding the perforation. If the hole is of some size, it is better not to attempt to close it.

A perforation in a septal membrane, unless too large, does no harm outside of an occasional crust which may adhere at the edge.

Many patients have perforations and would never know it unless informed of the condition.

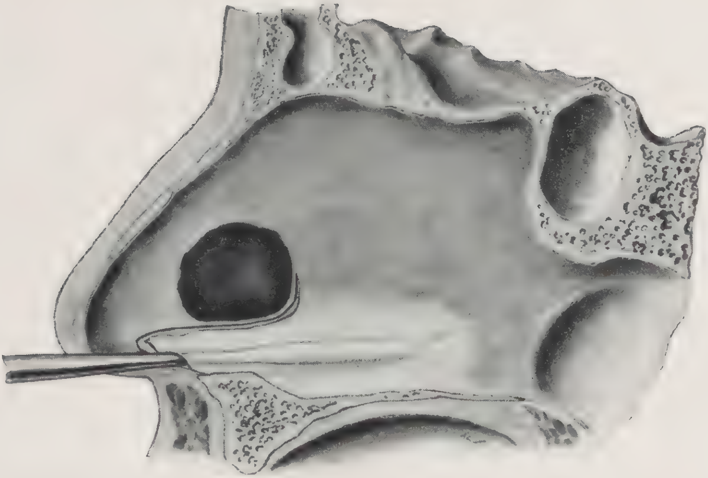

Fig. 68.—Incision around the perforation and elevation of the flap.

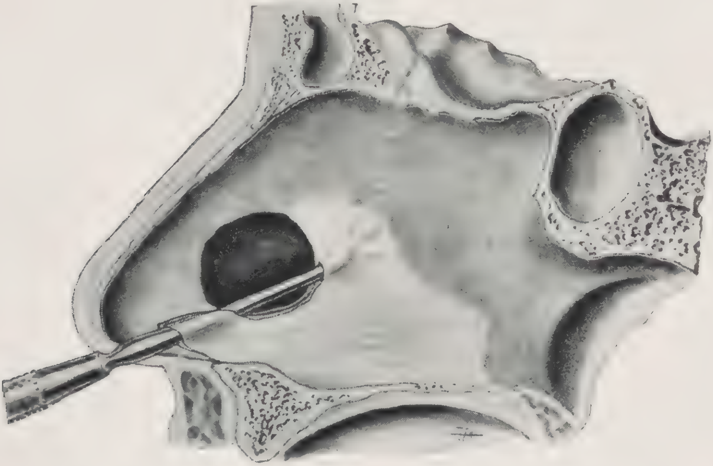

Fig. 69.—Elevating the flap from behind the perforation with the angular elevator.

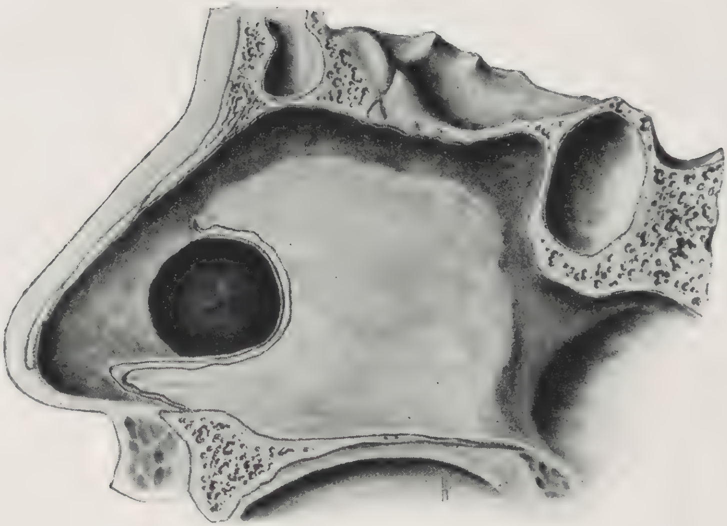

Fig. 70.—The complete cut in a re-operation on the septum with a perforation.

CHAPTER VII.

Dips in the Nasal Bridge.

A DIP in the nasal bridge may be due to one of several causes. First, to a blow on the nose, which breaks down the cartilaginous bridge and at the same time causes a deflected septum. Second, to an abscess high up under the ridge of the nose which destroys the cartilage and produces the dip by the contraction of the tissues after the abscess heals. Third, it may follow a submucous resection. Accidentally during a submucous resection too much cartilage may be removed, weakening the septal support. The duck bill forceps should not be used to remove the cartilage, as it is an easy matter to dislocate it high up along the under side of the ridge.

In the healing following a submucous resection, the contraction of the tissues may cause a dip. Here enters the special predisposition on the part of the individual, why do the scar tissues of some people, in healing, contract more than others? For instance after a beautiful tonsillectomy, the throat may look perfect, yet a month later it may show marked contractions.

In cases of syphilis, there is always a contraction of tissues when healing takes place.

A diagram should be made on the patient's record card before the operation, showing any dip or changes, from the straight line, of the tip of the nose.

In nearly every case, a patient with a deflected septum has at least a slight dip, due to the deflection.

If the tip of the nose is off to one side, the bridge may appear to have no dip, but after the submucous resection, the spring in the cartilage which held the tip over and slightly down, is broken; the tip now comes back to the straight line and turns slightly up, and the dip which has always been present, now shows.

The light reflex along the bridge, which the patient is accustomed to seeing, is also changed, and this leads him to believe something has happened to his nose.

Large dips in the nasal bridge must be taken care of by some plastic operation, where a piece of cartilage, bone or a celluloid plate is introduced under the skin.

Small dips, and these are the kind found most frequently in cases of deflected septa, can be relieved by the injection of paraffin.

Paraffin has been used, especially by "beauty doctors," to relieve all kinds of deformities, with disastrous results, and so has fallen into disrepute.

We recommend its use only in the cases with the small dips. These dips are not large enough for a

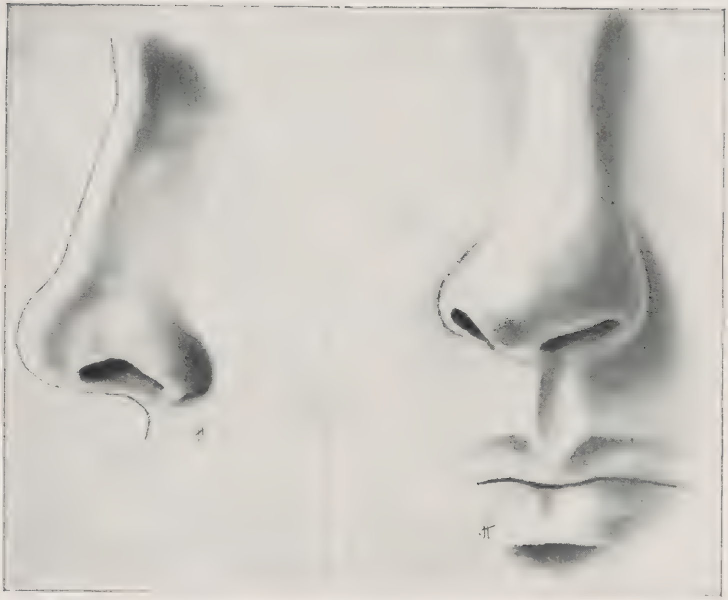

Fig. 71.—Side view showing dip in nasal bridge. Front view showing nose bent to the right.

plastic operation but a few drops of paraffin will restore the bridge to its straight line.

The paraffin used has a melting point of one hundred and ten degrees Fahrenheit. It comes, from the instrument maker, sterilized, in glass tubes with a cork in each end. When ready for use, the tubes are washed in mercuric chlorid or alcohol, the corks removed and the paraffin forced into the syringe.

The best syringe is the Beck, with the screw plunger, and a needle bent at an angle of about forty-five degrees.

As the paraffin has a high melting point and is used cold, the screw plunger on the syringe will be necessary to force the paraffin between the tissues.

The end of the nose is sterilized with iodin followed by alcohol and about one or two drops of one-half of one per cent. of cocain injected. The Beck syringe and needle is sterilized and filled with the paraffin, the lock set and the plunger screwed down on the paraffin until the air is out of the syringe.

The needle of the syringe is forced through the end of the nose and the point brought into the center of the dip well under the skin. The plunger of the syringe is now slowly screwed down and the dip gradually filled, moving the point of the needle as necessary to fill the hollow.

The fingers of an assistant should be held against the side of the dip to keep the paraffin in place, also

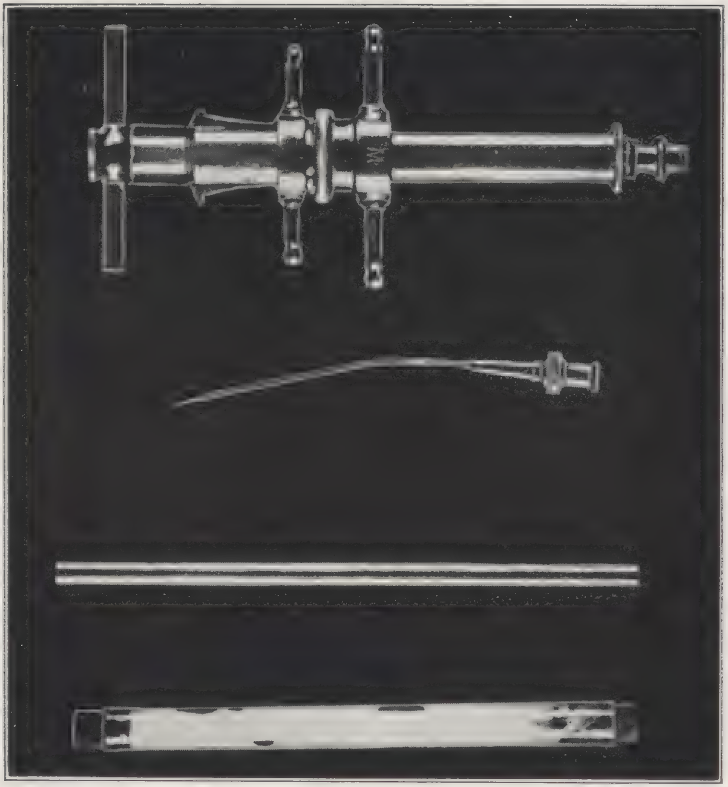

Fig. 72.—Instruments. 1. Beck paraffin syringe. 2. Needle. 3. Plunger to force paraffin from glass tube into syringe. 4. Glass tube filled with paraffin.

when the point of the needle is high up, to keep one finger on the bony crest to prevent the paraffin from over-riding the nasal bones.

As the hollow is gradually filled, the fingers are used to mold the paraffin. Care should be used never to over-fill the hollow, if anything, under-correct, as the operation can be repeated later if necessary. After the needle is removed, the puncture is sealed with collodion.

The patient should be warned to keep his fingers off his nose until the paraffin is fixed, to avoid changing the shape.

Never perform the operation in extremely cold weather, as the skin over the paraffin might freeze, the circulation being somewhat interfered with for the time being.

In some cases, the skin over the paraffin will be red, due to the pressure of the paraffin interfering with the circulation, but as a rule, this lasts but a short time.

Some authors believe the mass of paraffin becomes encapsulated like a foreign body, others that it is surrounded with a connective tissue wall and that fibrous bands traverse the mass and subdivide it. The paraffin probably finally becomes absorbed and all that is left is a new connective tissue mass of cartilage-like consistency. The time required for this absorption varies from one to four months, according to the amount injected and to the individual.

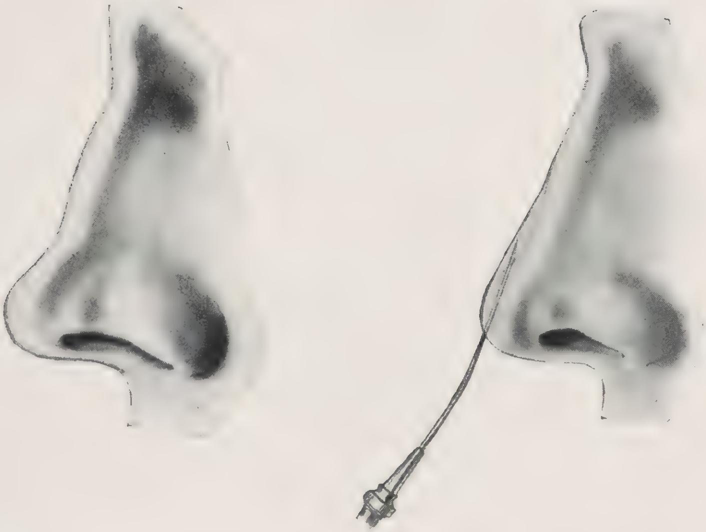

Fig. 73.—Side view of the dip in nasal bridge. Also showing position of needle to fill dip with paraffin.

CHAPTER VIII.

Development of the Lateral Wall.*

To have an operative idea of the problems to be met, one must know at least the main points in the development of the lateral wall of the nasal cavity. While the nasal pits are noticeable early in embryological life, it is not until the forty-fifth day that the lateral wall shows some definite markings. The primary furrow is now brought in relief by the thickening of the lateral wall below and in front, which becomes the lower turbinate below and the uncinate process above. Posteriorly and above this furrow, is the thickening which becomes the ethmoid body. It is this important furrow which becomes the middle meatus and hides in its depths the infundibulum ethmoidalis. At this stage of embryonic life, are the markings on the lateral wall of the future lower meatus, the lower turbinate, the middle meatus and the ethmoid body. The nasal fossa and mouth are one cavity.

In the next ten to fifteen days, are added to the lateral wall, two new furrows, which becomes the superior and supreme meati. Fusion of the palatine processes that develop from the mesial side of the

* For thorough embryological study of the nose, we refer you to "The Nose and Olfactory Organs," by Schaeffer.

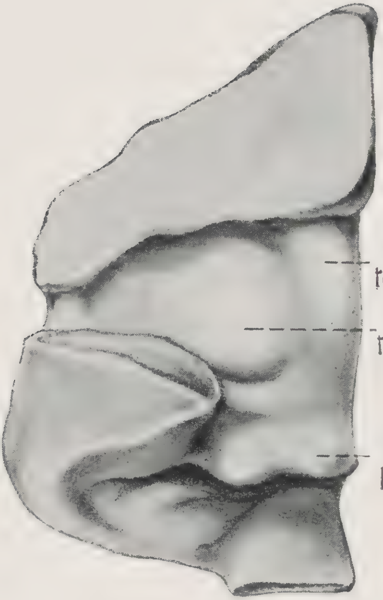

Fig. 74.—The development of the lateral wall on the forty-fifth day. The mouth and nose are still one cavity. The swelling of the future inferior turbinate is the most prominent feature, while the swelling of the ethmoidal region which contains the middle turbinate, is just showing. The furrows of the inferior and middle meati can be recognized. (After *Schaeffer.*)

maxillary processes close the opening between the nose and mouth, making then independent cavities. The fusion of the medial process (or septum) centrally with the palatine processes divides the nasal cavity into two nasal fossæ. From the second to the third months, the permanent inferior and middle turbinates are beginning to assume their recognizable form.

The anlage or beginning development of the paranasal cells is first noticed as a dipping in or evagination of the mucous membrane into the lateral wall, always in a lateral wall furrow. As the evagination grows and becomes cell-shaped, it is surrounded by tissue which later changes to bone as the future size of the cell is reached.

The evaginal point is the future ostium of each cell, and the name of the cell is at once determined by the position of its ostium.

The three principal furrows of the lateral wall are of particular interest. It is from the first or primary furrow, with its accessory furrows, that we have the beginning of the future middle meatus, from which later are evaginated the antrum, the bulla cells, the infundibular cells, the frontal and agger nasi cells.

Aside from the antrum, which is a true anterior ethmoidal cell, as its ostium is in the middle meatus, these cells comprise the anterior ethmoid group.

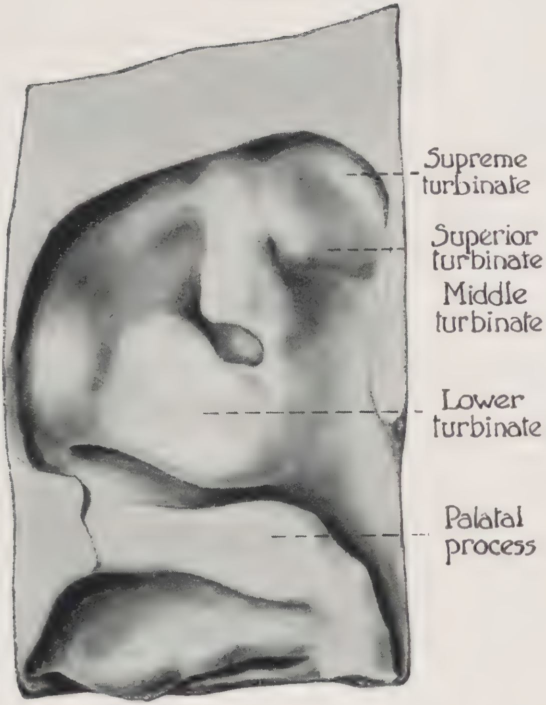

Fig. 75.—At the fiftieth day, the lateral wall has developed rapidly. The inferior turbinate has its beginning overhang and the lower meatus is well marked. The ethmoidal region is furrowed so the swelling of the middle turbinate, superior turbinate and supreme turbinate show. The middle meatus furrow and the superior meatus furrow are particularly well marked. The palatal process has straightened out and is ready to unite with its fellows of the opposite side to close the mouth from the nasal cavity. (After *Schaeffer.*)

According to modern nomenclature, all cells opening into the middle meatus are anterior ethmoidal cells.

From the superior or secondary furrow, is formed the future superior meatus and the evagination of two posterior ethmoidal cells. From the supreme furrow, which is present in about sixty-two per cent. of cases, is evaginated one posterior cell. It is this cell that occasionally occupies the sphenoid bone, in a position above the normal sphenoidal sinus.

The sphenoidal sinus is the exception in the sinus formation by evagination. It is formed by a constriction from the upper and posterior portion of the nasal fossa, lying against the body of the sphenoid into which it develops. At this point of constriction, is formed the spheno-ethmoidal recess, into which the sphenoidal sinus opens at about the level of the supreme meatus.

On the one hundred and tenth day, the inferior turbinate is a definite body, marking well the lower meatus. The middle turbinate shows its definite overhang from the ethmoidal body, covering the middle meatus with its developing furrows and folds (the future uncinate process and ethmoidal bulla).

From now on the inferior, middle and superior turbinates develop rapidly with the thickening lateral wall. This is particularly true with the middle and

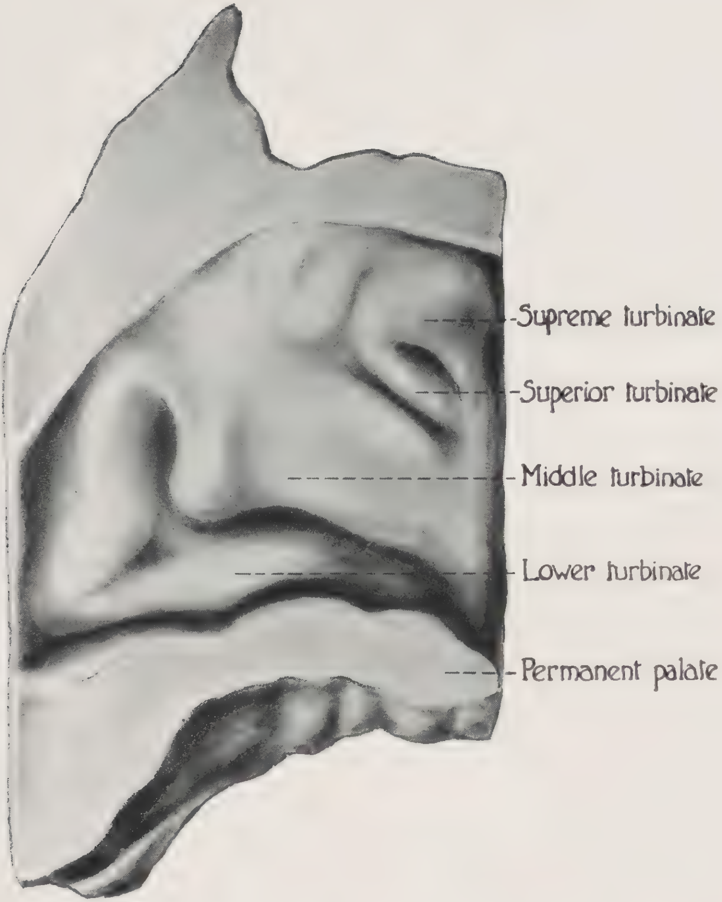

Fig. 76.—At one hundred days shows the prominent swelling of the turbinal bodies with their meati between. The lobulus on the angle of the middle turbinate is large at this stage of development. The palate is permanent and the mouth and nose are two separate cavities. (After *Schaeffer.*)

superior turbinates, due to the rapid enlargement of the anterior and posterior ethmoidal cells.

At the knee or where the ascending and descending portions of the middle turbinate meet, is frequently an enlargement called the lobulus. This lobulus sometimes becomes large enough to interfere with ventilation and drainage of the middle meatus. At this point there often develops an ethmoidal cell, causing what is known as a cystic middle turbinate, or ethmo-turbinal cell.

UNCINATE PROCESS.

The uncinate process (processus uncinatus) is a long, thin, scimitar-shaped bone (accessory turbinate) attached high up just under the anterior superior attachment of the middle turbinate. It lies at an angle of about forty-five degrees with the lateral wall, with the anterior edge touching the lachrymal bone. At its upper beginning it follows the contour of the nasal process of the maxillary bone but soon curves backward, following and just under the edge of the middle turbinate. It terminates about in the middle of the hiatus maxillaris and gives the bony hand-shaped frame that supports the membrane, which covers this opening.

Near the posterior end of the process and partly covered by it, is located the ostium maxillaris. It is from this point, which is the lower end of the

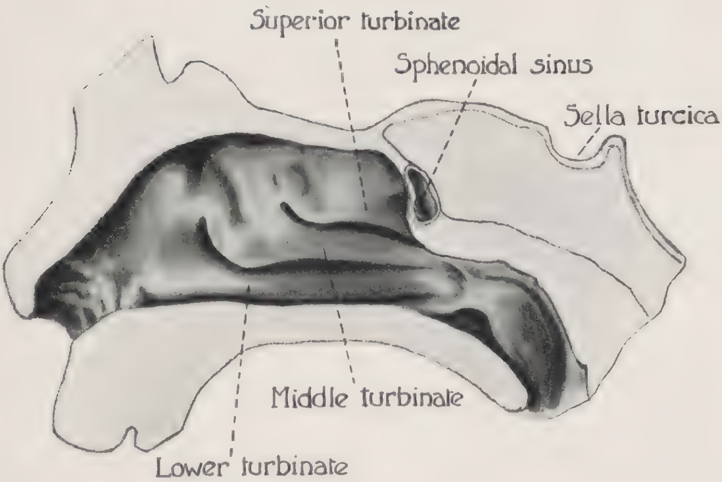

Fig. 77.—The lateral wall at birth. The three turbinates and three meati are as clear and distinct as in the adult, only of smaller size. The beginning development of the sphenoidal sinus as it lies under the mucous membrane and against the body of the sphenoid bone is also shown.

infundibulum ethmoidalis, that the antrum is evaginated.

The finger-like projections at the end of the uncinate process articulate with the ethmoid process of the inferior turbinate and portions of the lateral wall. These portions of membrane, which lie between the fingers of the uncinate process, are known as the nasal fontanelle, and when these membranous walls are broken, form the accessory ostia of the maxillary sinuses. The accessory ostia of the maxillary sinuses always open into the middle meatus, while the true ostium opens in the floor of the infundibulum ethmoidalis. Any secretion from the antrum must pass through the hiatus semilunaris to reach the middle meatus if it passes through the natural ostium. The posterior superior surface of the uncinate process forms the anterior inferior wall of the infundibulum ethmoidalis, while its curved posterio-inferior thin edge forms one margin of the hiatus semilunaris, the bulla ethmoidalis forming the other.

THE BULLA ETHMOIDALIS.

The bulla ethmoidalis is first noticed as a swelling just posteriorly to the uncinate process which curves around its anterior border by three furrows from which are evaginated the cells which afterward occupy it. The bleb-like protuberance projects medially, leaving an under-shelving in its contact with

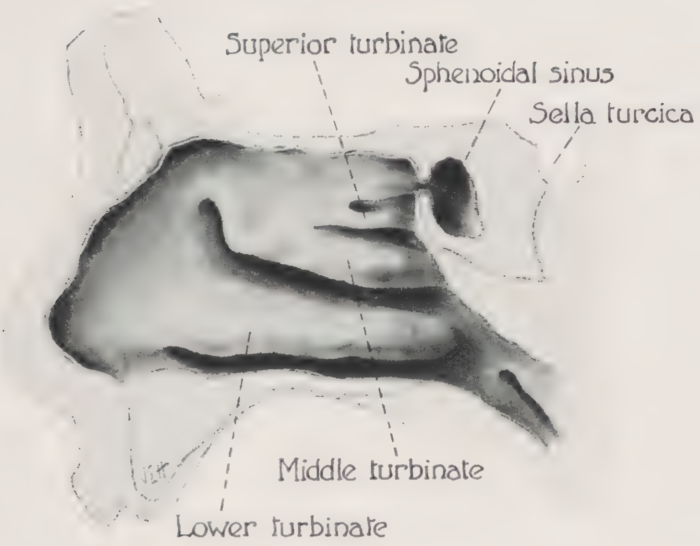

Fig. 78.—The lateral wall at seven years. The markings are normal, only smaller in comparison with the adult. The sphenoidal sinus shows about half of its normal development.

the lateral wall. It is this under-shelving space, lying under the edge of both the bulla and uncinate process and follows the complete contour of the bone, that is known as the infundibulum ethmoidalis.

These bulla cells which compose the bulla ethmoidalis open into the bulla recess which is one of the bulla furrows and from there into the middle meatus. The ostia, being in the superior part of the cells, do not give gravity drainage and these cells are frequently affected and often show polypoid degeneration.

THE INFUNDIBULUM ETHMOIDALIS.

Owing to the definition given the hiatus semilunaris and the infundibulum ethmoidalis, by the Basle Commission in 1895, there has been great confusion in describing these spaces. The infundibulum ethmoidalis is the space on the bony lateral wall of the nose, extending from the lower end of the fronto-nasal duct to the ostium of the maxillary sinus. It is bounded laterally by the lachrymal bone and the mesial wall of the maxillary sinus, anterio-inferiorly by the uncinate process, and posterio-superiorly by the bulla. It communicates with the middle meatus, by a semilunar-shaped opening, formed by the sharp edge of the uncinate process with the bulla ethmoidalis, which is known as the hiatus semilunaris. At the lower end of the in-

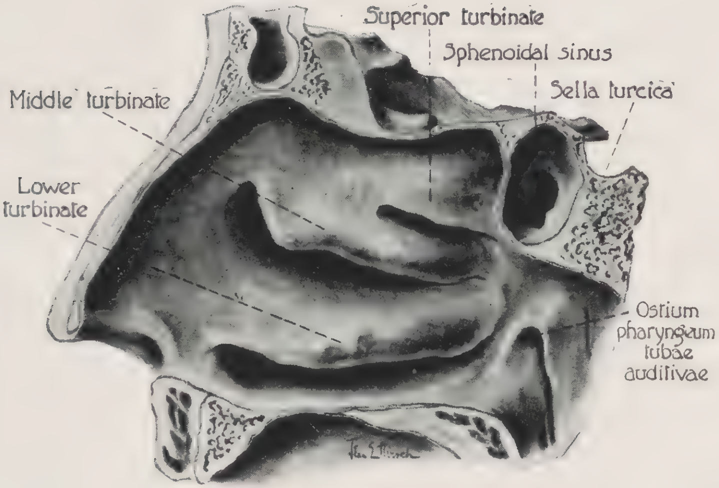

Fig. 79.—The lateral wall in the adult. The sphenoidal sinus occupies that portion of the body of the sphenoid bone lying anterior to a perpendicular line drawn through the anterior wall of the sella turcica.

fundibulum ethmoidalis is evaginated the sinus maxillaris, while its upper end may terminate blindly or in an anterior ethmoidal cell. This anterior ethmoidal cell may develop into the frontal sinus and when this takes place, we have direct communication from the frontal sinus to the maxillary sinus. A number of anterior ethmoidal cells empty, in an indirect way, into the infundibulum ethmoidalis, which would allow any discharge from such a cell to run down the infundibulum into the sinus maxillaris. Fifty-three per cent. of the frontal sinuses are developed directly or indirectly from anterior ethmoidal cells, and forty-seven per cent. develop directly from the frontal recess which is the upper part of the middle meatus. This fifty-three per cent. explains some of the reasons why the antrum acts as a reservoir for a suppurating ethmoidal or frontal sinusitis. In order for the antrum to act as a reservoir, it is necessary that there be either an extremely large ostium or an accessory ostium to allow the air to escape as the discharge enters. An accessory ostium of the maxillary sinus is present in forty-two per cent. of adult cases. The infundibulum ethmoidalis acts as a draining trench, protected by bony walls, so is not easily compressed, and thus keeps open many cells, the ostia of which would otherwise be closed during inflammations. The drainage by the infundibulum may account for the absence of vacuum

headache when the nose is apparently completely closed by congestion. At birth the lateral wall has all the markings and cells of the adult but on a smaller scale.

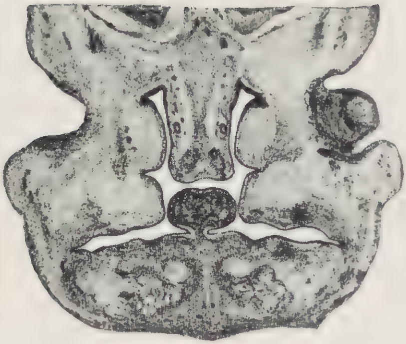

Fig. 80.—The beginning of a series of six views, showing coronal sections of the nasal region as near as possible to the ostium of the maxillary sinus. This drawing was made at the forty-third day of fetal life. The parts we wish to emphasize and carry through the series are, first, the ethmoidal region; second, the maxillary region; third, the palatal process, and fourth, the septum. From the ethmoidal region is developed the ethmoidal capsule, the middle, superior and supreme turbinates and the frontal sinus. From the maxillary region, the lower turbinate and the antrum. The palatal process forms the roof of the mouth, the floor of the nose. At this age the nasal and oral cavities are one.

Fig. 81.—The nasal region of a sixty-five day fetus. The palatal processes have united and separate the nasal fossa from the mouth. The septum has also united at the medial line of the palatal process and divides the nasal cavity into a right and left nasal fossa. The inferior turbinates are well marked. Above the inferior turbinate is the middle furrow, off of which is seen a part of the infundibulum ethmoidalis at the lower end of which is evaginated the maxillary antrum. The ethmoidal region is further developed and the overhang of the middle turbinate well marked.

Fig. 82.—The nasal region of a fetus at one hundred and twenty-one days. The lower meatus, inferior turbinate, middle meatus and overhang of the middle turbinate are well marked. The infundibulum ethmoidalis shows at its lower portion the beginning evagination of the maxillary antrum.

Fig. 83.—The nasal region of a newborn babe. The section is just posterior to the ostium of the antrum but shows the well marked antra which are very small at birth. The ethmoidal region is well developed, the bulla ethmoidalis, middle and superior turbinates and ethmoidal cells are well marked.

Fig. 84.—The nasal region at four and one-half years. The meati and turbinates are well developed, and the opening of the maxillary antrum under the middle turbinate clearly marked. The ethmoial cells are well shown.

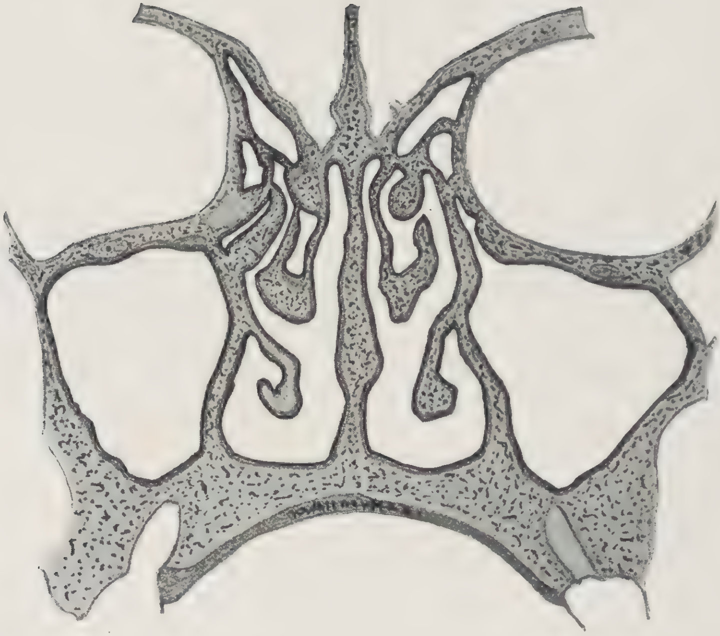

Fig. 85.—The nasal region of an adult. The well developed turbinates, meati, antra and ethmoidal cells give a good idea of the location of these important structures.

CHAPTER IX.

Localized Anatomy of the Lateral Wall.

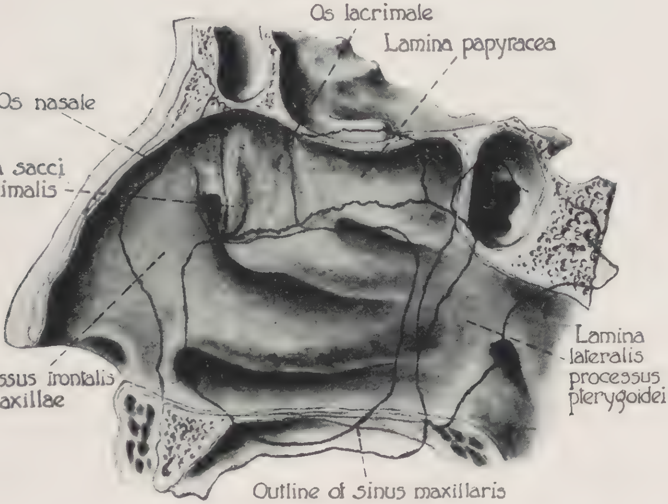

Fig. 86.—An idea of what lies under the structures of the lateral wall in relation to the position of the turbinates. The fossa of the lachrymal sac lies in the hard bone of the nasal process (processus frontalis maxillæ) of the maxillary bone, in front of the attachment of the middle turbinate. The anterior ethmoidal cells may lie in direct contact with this fossa and be responsible for inflammation of the lachrymal sac. The lachrymal base (os lacrimale) is the lateral wall of the anterior ethmoidal cells, while the orbital plate (lamina papyracea) is the lateral wall for some of the anterior ethmoidal cells and all of the posterior cells. The size and position of the antrum maxillaris is shown.

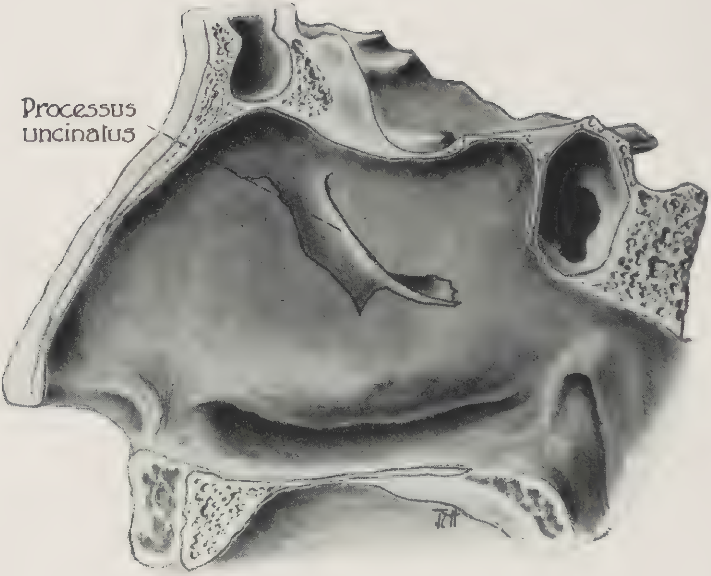

Fig. 87.—The position of the uncinate process. It is a scimitar-shaped bone, attached to the lateral wall just back and under the middle turbinate, at an angle of forty-five degrees, the posterior lip which is the elevated portion, forms the anterior edge of the opening called the hiatus semilunaris. The lower part of the uncinate process helps to form the hiatus semilunaris.

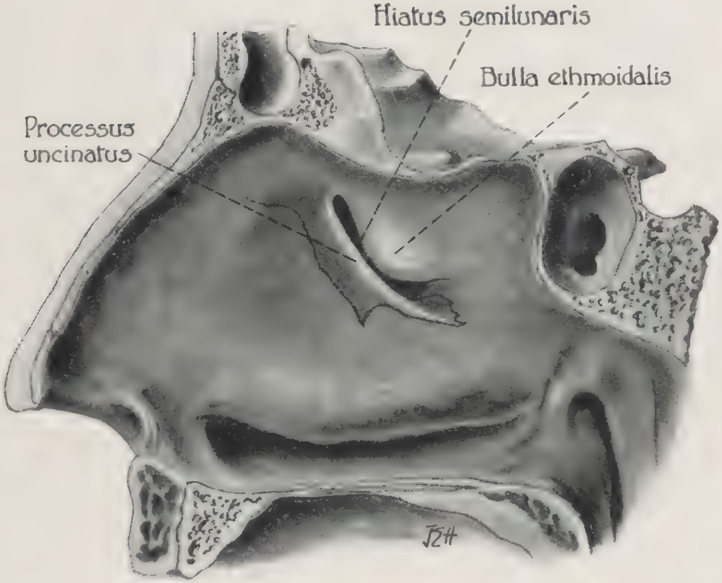

Fig. 88.—The bulla ethmoidalis in position just posterior to the uncinate process. It shows clearly how its anterior edge, with the posterior edge of the uncinate process, forms the semilunar opening (hiatus semilunaris) of the infundibulum ethmoidalis

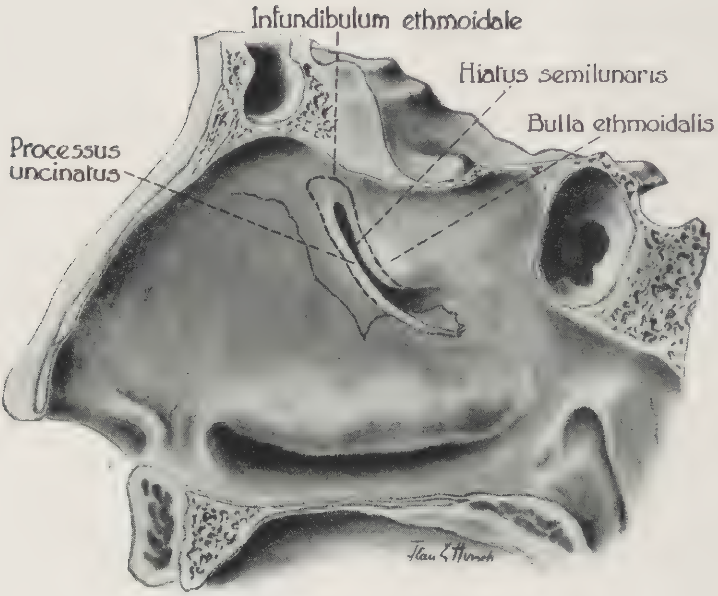

Fig. 89.—The uncinate process and ethmoid bulla and how the overhang edges of these two processes, together with the orbital wall as a floor, form a trough-like space, known as the infundibulum ethmoidalis. This trough-like space, runs from the roof of the nose near the opening of the frontal sinus to the ostium maxillaris. The infundibulum is entirely surrounded by bone except where the thin edges of the uncinate process and ethmoidal bulla nearly meet. The slit between these two processes forms a semilunar opening called the hiatus semilunaris. The infundibulum then is a tube while the hiatus semilunaris is a slit in its side.

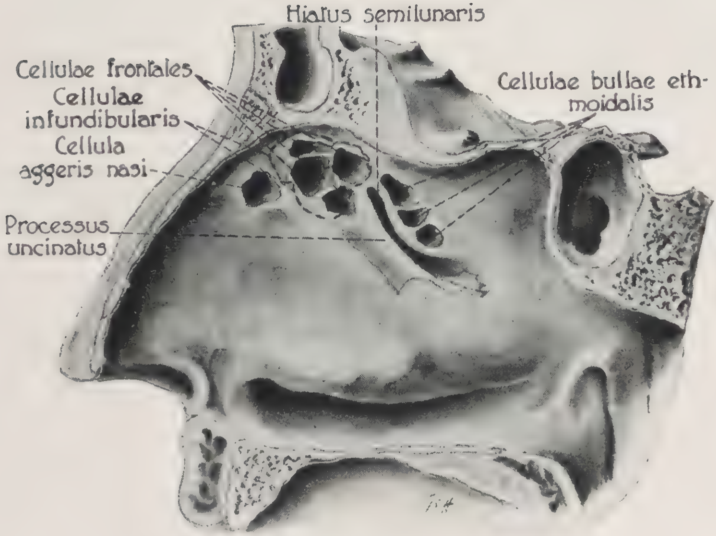

Fig. 90.—The group of cells and their positions under the middle turbinate, which collectively compose the anterior ethmoidal cells. They are known as the agger nasi cell, the infundibular cells, the frontal recess cells and the bulla cells. The agger nasi cell is not always present. When present it lies just above and anterior to the anterior attachment of the middle turbinate. The infundibular cells are posterior to the agger nasi cell but nearer the lateral wall. They vary in number from one to four, and open directly or indirectly into the infundibulum. The frontal recess cells lie mesially to the infundibular cells. They vary in number from one to four and open into the frontal recess. The bulla cells are posterior to all these cells. They vary in number from one to four and open into the bulla recess and then into the middle meatus.

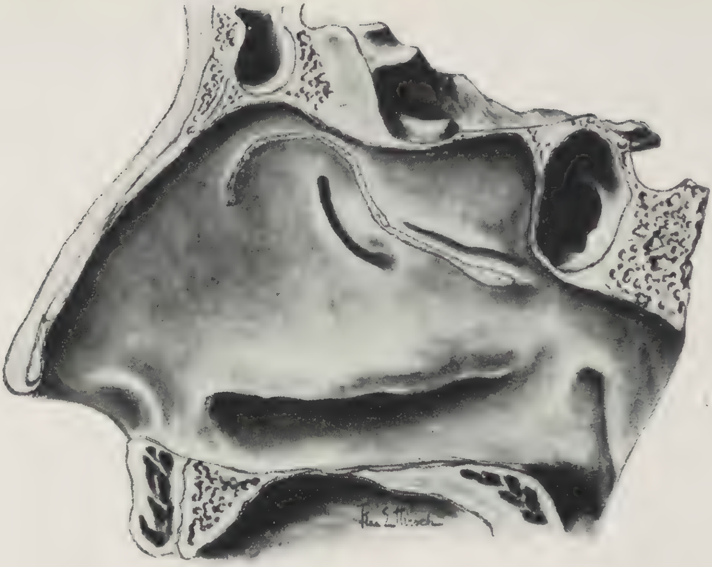

Fig. 91.—The attachment of the middle turbinate.

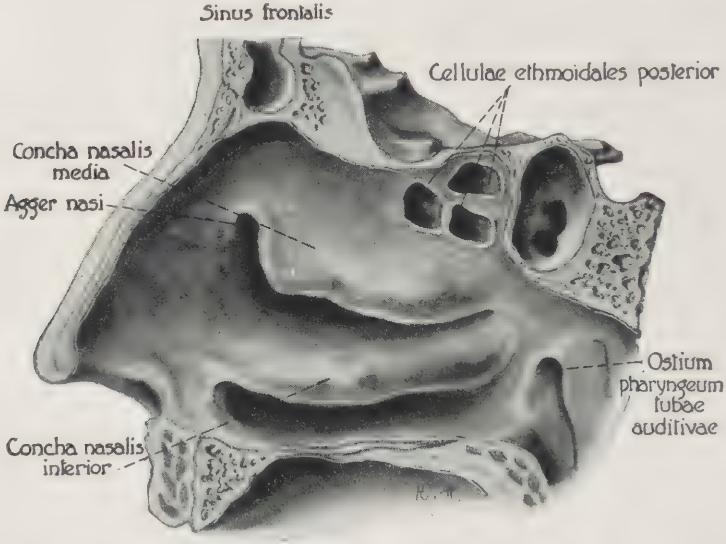

Fig. 92.—The group of cells and their position under the superior turbinate, known as the posterior ethmoidal cells.

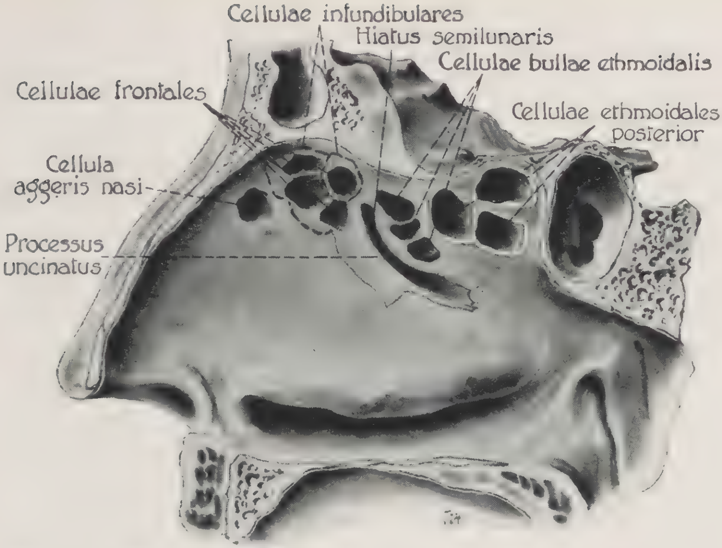

Fig. 93.—How the anterior ethmoidal cells, the posterior ethmoidal cells, and the sphenoidal sinus are on a line with each other.

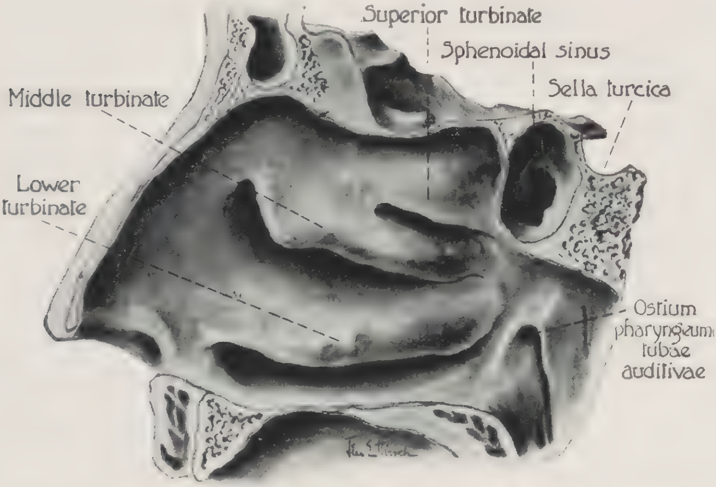

Fig. 94.—The lateral wall covered and protected by the turbinates. The normal sphenoidal sinus occupies the anterior half of the body of the sphenoid bone, and the anterior wall of the sella turcica marks the posterior wall of the sphenoidal sinus.

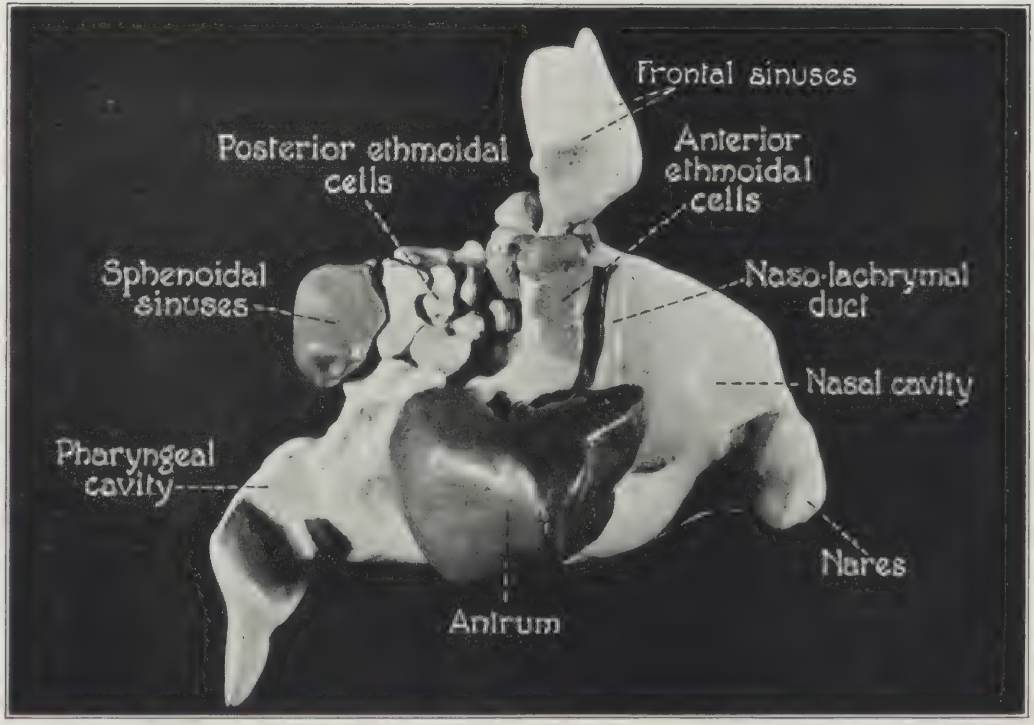

Fig. 95.—In order to help to visualize the paranasal sinuses and the nasal cavities, we present six views of a wax model of the nasal cavities and sinuses made by Dr. C. E. Connor, in the Anatomical Laboratory of the Medical School, University of Minnesota. A right side view of the wax model of the nasal cavities and sinuses.

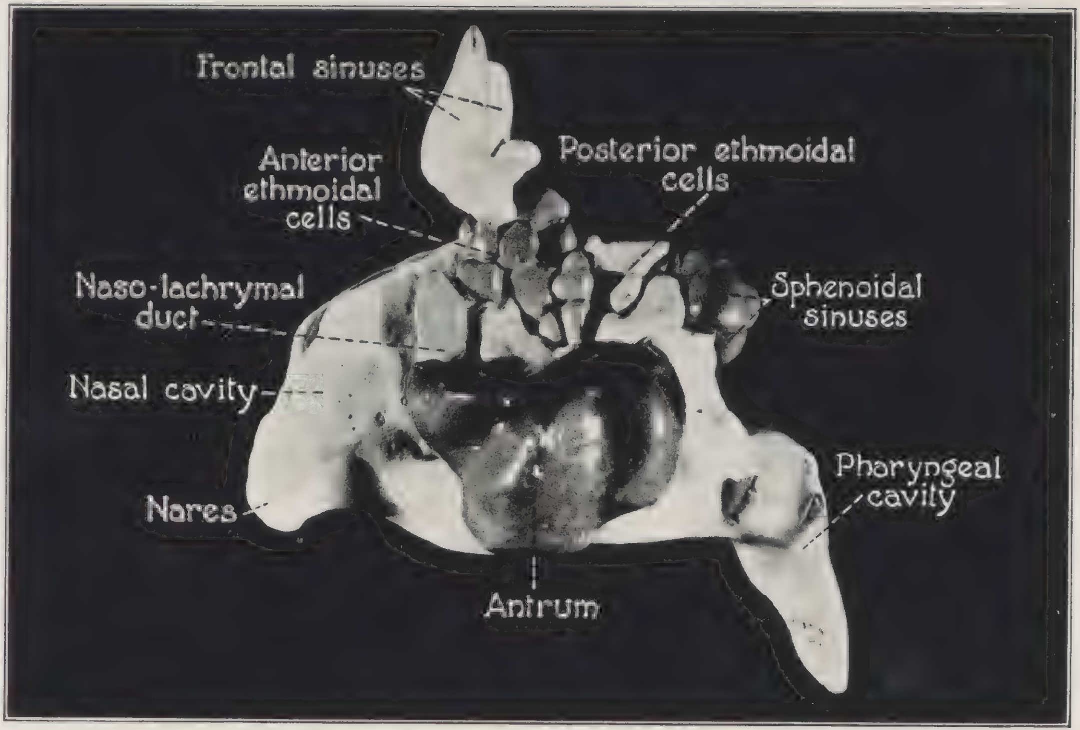

Fig. 96.—A left side view of the wax model of the nasal cavities and sinuses.

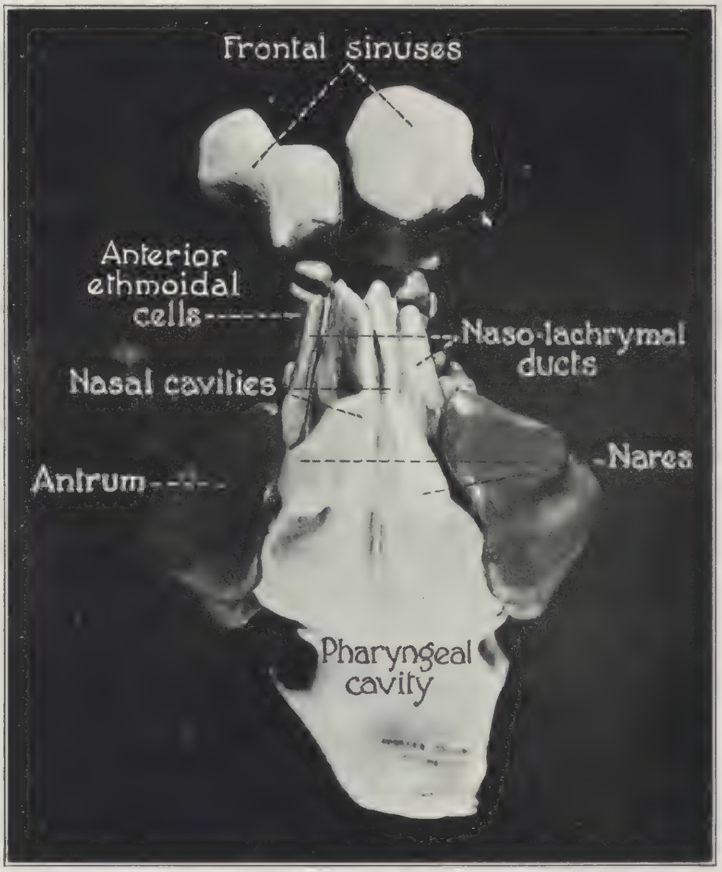

Fig. 97.—A view looking from before backward on the wax model.

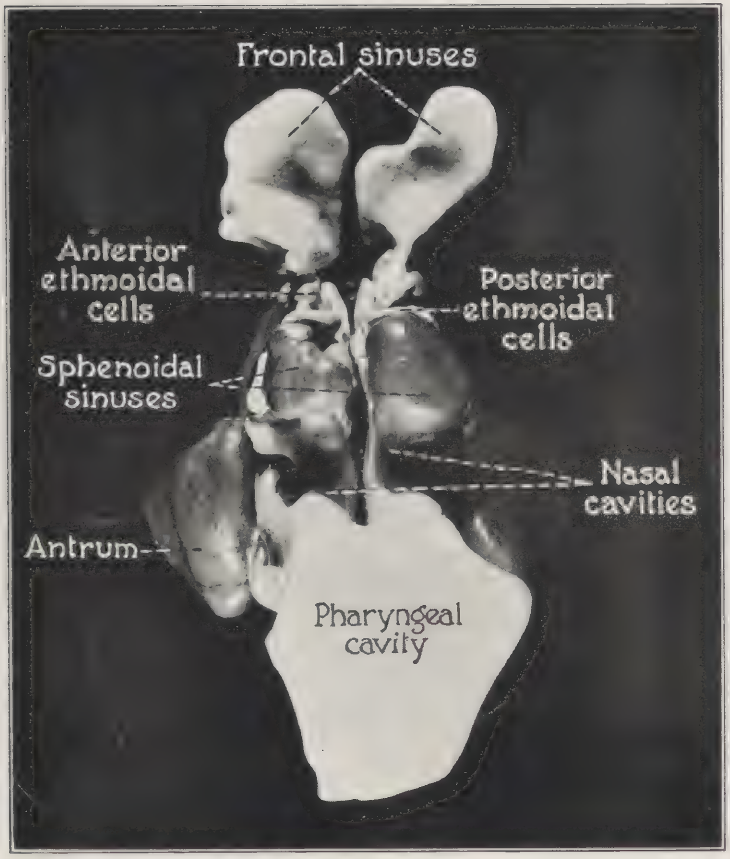

Fig. 98.—A view looking from behind forward on the wax model.

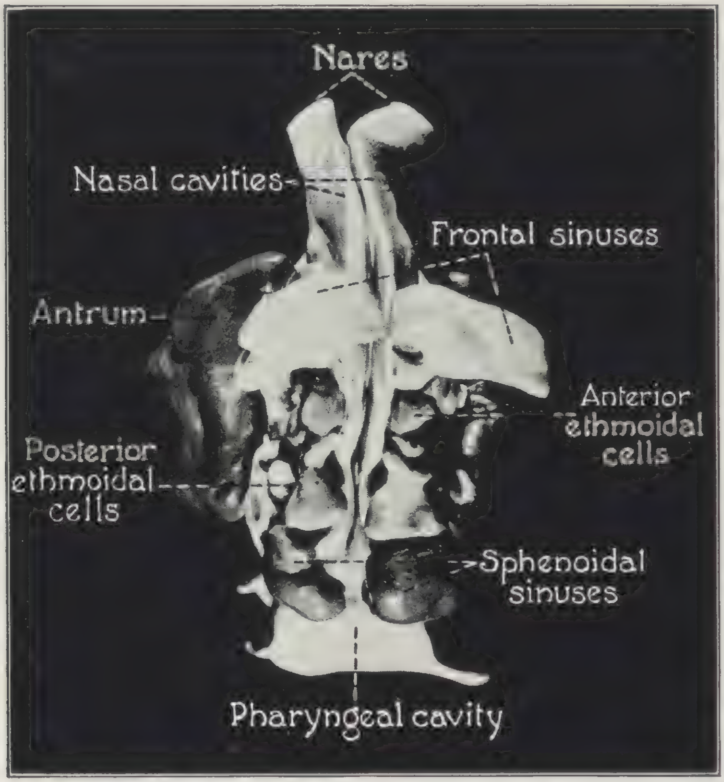

Fig. 99.—A view looking from above downward on the wax model.

Fig. 100.—A view looking from below upward on the wax model of the nasal cavities and sinuses. The frontal, anterior and posterior ethmoidal and sphenoidal cells are sketched in on one-half to show their relative positions from below.

CHAPTER X.

Head Pains.

HEAD pains, resulting from sinus disease, are the most frequent and the least understood of the entire symptom-complex. While one may not be able to diagnose a sinusitis by the pain alone, taken with the other clinical signs, the diagnosis is often easy. The absence of pain many times means that the secretions are not confined within the sinus, or the inflammation has not spread to some sensory nerve or ganglion. The patient ofttimes simply complains of a general headache and it will take close questioning to place the cause on some definite sinus. The fact that we may have a number of the sinuses affected at the same time, or some ganglion inflamed by the nearness of a diseased sinus, cause the pains to often overlap so that a correct diagnosis is impossible.

A congestive headache is generally easy to differentiate. Pressure on the septum at any point by hypertrophies of the lateral wall, as for example the middle turbinate, does not cause headache; but the pressure of a deflected septum against the middle turbinate, either by direct or leverage pressure, congests or closes the ostium of the sinus lying underneath, thus causing pressure pain from a confined

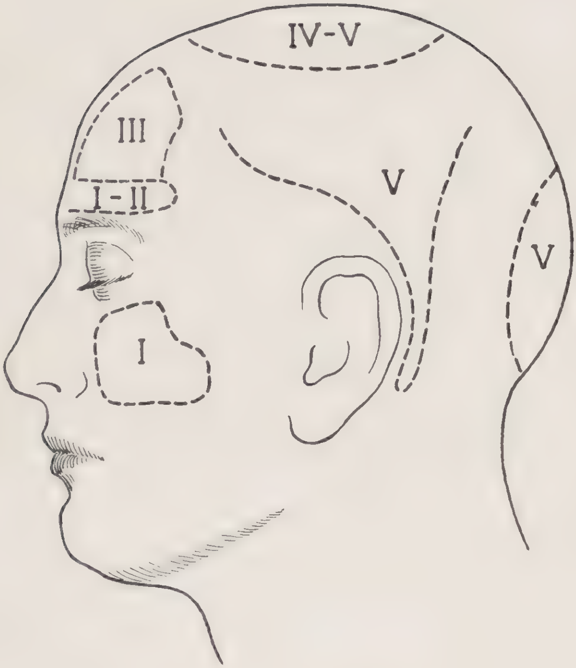

Fig. 101.—Areas of head pains.

discharge, or a vacuum pain by negative pressure on a hypersensitive sinus membrane.

Some cases, having little or no pain, show enormous tissue changes, while the most severe and unbearable pain often comes when we are unable, from inspection, to diagnose a sinus disease. There must be some microscopical changes that cause these severe nerve reactions. Ganglionic inflammation is undoubtedly the answer to these unbearable pains.

Gruenwald claims, that in acute sinus inflammation there is always pain, while in the chronic form there is pain in only about one-half the cases. The character of the pain may be a diffused headache, of the dull, heavy, full type and may be accompanied by the neuralgic type, or be the neuralgic type alone. It may be continuous or come on and stop at definite hours. As most of the sinus pains are from positive or negative pressure, they disappear quite suddenly on the release of this pressure. This sudden cessation of pain is characteristic of sinus disease.

The acute paroxysms of trifacial neuralgia, ear and teeth pains are easily diagnosed. The supraorbital and infraorbital neuralgias are localized and have their tender points, although both may be caused by sinus trouble indirectly.

While individual sinuses seem to show some predilection for referring pain to certain locations, there is no one definite location for each sinus. The crossing of the sympathetic with the sensory nerves

complicates and blurs the references, and while the sinus will give a more intense pain at one certain point, there will be radiating pains to other places that seem entirely unconnected with the affected sinus.

MAXILLARY SINUS.

In acute maxillary sinusitis, there will be hard definite pain over the cheek, intensified by leaning the head forward and downward. There may also be radiating pains at that side of the head and neck, from extended inflammation to the nasal ganglion. Pain in the supra-orbital nerve is due, undoubtedly to a reflex through the sympathetic.

FRONTAL SINUS.

In frontal sinusitis there is generally definite pain over the eye of the side affected, with radiating pain over that half of the head. The skin and hair are tender on light touch. An intense localized fullness, with or without pain, is felt when the head is lowered forward. If suppurative, the pain is more severe on awaking, or soon after, and leaves about noon, but if only congestive, it may be continuous. If a suppurative pressure pain, it generally lessens or disappears at night on account of the relieved congestion by reduced blood-pressure, slowed heart action, and a decreased secretion. At night, when we lie supine, the ostium of the frontal sinus is located anterio-

inferiorly, the weight of the discharge is backward, away from the opening which becomes more patulous, and can receive the assistance of the cilia of the mucous membrane in the passage of the discharge. When in the upright position we have not only the weight pressure of the discharge, but the mucous membrane is congested by the increased activity of the patient, all of which tends to block the ostium. The accumulation of the secretion brings the pressure pain, which is relieved when the secretion passes out.

ANTERIOR ETHMOIDAL CELLS.

The anterior ethmoidal cell inflammation gives pain and fullness between the eyes and over the bridge of the nose.

POSTERIOR ETHMOIDAL CELLS.

In the posterior ethmoidal inflammation, the pain is not only between the eyes, but there is a pressure pain, as if the eyes were being pushed forward.

SPHENOIDAL CELLS.

In sphenoidal suppurative inflammation there is a full feeling in the center of the head as if something would burst. There are also radiations to the top and back of the head and over the ear. If the nasal ganglion is affected, as it frequently is on account of its position in the spheno-maxillary fossa, close

to the sphenoidal sinus, there will be the symptom-complex of the nasal ganglion (spheno-palatine ganglion) pain back of the ear, down the neck, shoulder and arm, added to the other symptoms.

NASAL GANGLION.

On account of the nasal ganglion lying as it does, between the sphenoidal and maxillary sinuses, it is affected by inflammation of these sinuses. In the nasal ganglion syndrome, one should always remember the possibility of disease of one or both of these sinuses.

The nasal ganglion inflammation is diagnosed from sinusitis, by placing a pledget of cotton wound on an applicator, dipped in epinephrin chlorid, and saturated in cocain snow, over the spheno-palatine foramen, which is located at the posterior end of the middle turbinate. The pain is generally relieved in ten minutes and the pledgets are left in position from twenty to forty minutes.

It is really surprising how confusing these head pains are to the patients, but careful questioning generally elicits definite answers so that with the clinical evidence, a diagnosis can be made.

VACUUM HEADACHE.

At least since 1891 we have had reported in the literature (Ewing, Brawley, Sluder), what have been called vacuum headaches, due to closure of the ostia

of some of the paranasal sinuses. The absorption of the air contained in the sinus causes a negative pressure, and when the sinus is opened, or the ostium becomes patulous, the headache disappears. If this condition can be proven with one sinus, one can believe that the same condition in other sinuses, will produce head pains. The frontal sinus vacuum headache is easily demonstrable, owing to the accessibility of these sinuses. There is a dull aching pain over one or both eyes, with frequently a localized pain spot on the top of the head.

There is tenderness on pressure (Ewing's sign), at the upper inner angle of the orbit. As the pulley of the superior oblique muscle of the eye is attached to the orbital wall in this region, use of the eyes for near work will bring eye complaints (asthenopia). The patients will often complain of their glasses, but proper refraction will not relieve the condition. The frequent reports of marvelous relief of pain and discomfort by wearing +.25 or —.25 cylinders or spheres were due to spontaneous relief of vacuum or suppurative sinus conditions.

We undoubtedly have the same answer to our low grade muscle asthenopias, so prevalent in past years, for our extrinsic muscles often lie in direct contact with the sinus walls.

Intranasal examination will frequently show an apparently normal nose, but generally one will find some anatomical defect such as narrow passages,

deflected septa, with hypertrophies, or hyperplasias of the bone and soft parts. As diagnostic ability becomes keener, one may be able to locate accurately the sinus or sinuses affected. Undoubtedly most of the trouble lies in the frontal or anterior ethmoidal cells.

OPERATIVE TREATMENT.

If the nose is narrow or the septum deflected, it may be necessary to perform a submucous resection. If there is a soft hypertrophy or lobulous of the anterior end of the middle turbinate, it should be removed by the snare, care being taken to preserve the normal contour and size of the turbinate. If there is a cystic middle turbinate present, the operation (elsewhere explained) should be performed for that condition. If the middle turbinate hugs the lateral wall, it should be infracted. The suction pump should not be used in vacuum headache as it aggravates the condition. If the correction of these conditions does not relieve the headaches, the anterior ethmoid cells should be exenterated and with the Thompson frontal rasp, the anterior portion of the naso-frontal duct removed, thus enlarging the opening to the frontal sinus. This can easily be performed without sacrificing any portion of the middle turbinate or disturbing its normal attachment.

There must be some pathological conditions beside the negative pressure that causes these headaches,

because we frequently find noses free from vacuum headaches, yet with all the conditions which have been described as causing vacuum headaches. It seems necessary to have the tissues in some special pathological state to allow certain nerve irritations when there is lack of ventilation.

CHAPTER XI.

Turbinates.

The lateral wall of the nose is divided by three projecting bodies into three portions. In the lower portion are the inferior meatus and inferior turbinate. In the middle portion, the middle meatus and middle turbinate. In the upper portion, the superior meatus and the superior turbinate.

On closer study, it would divide more advantageously into an upper and lower portion. The lower portion containing the less important inferior turbinate and meatus, the upper portion, the all important ethmoidal mass overhanging the middle meatus. In this ethmoidal mass we recognize the lower part of the so-called middle turbinate, as the "overhang" of the ethmoidal mass, while the upper portion of the middle turbinate, with the superior turbinate, form the mesial wall of the ethmoidal mass. It is this mesial wall that is left intact, when the anterior and posterior ethmoidal cells are exenterated; or the sphenoidal sinus is opened, if the "under the middle turbinate" technic is employed.

The embryonic beginning of the turbinates and meati is first a furrow in the middle of the lateral wall called the primary furrow. This becomes the middle meatus. Below this furrow is the swelling

fold of the inferior turbinate and above this furrow is the swelling fold of the ethmoidal mass. More furrows and folds appear until markings of the lateral wall are complete.

THE INFERIOR TURBINATE.

The inferior turbinate is an independent scroll-like bone formed by the infolded border of the lateral plate of the cartilaginous nasal capsule. It articulates with the turbinal crest of the maxilla, completes the lower portion of the naso-lachrymal canal, and helps to close the hiatus maxillaris. It is covered by a thick mucous membrane in which lies the venous plexus, which is known as the erectile tissue. Its mission is to moisten and warm the air and regulate the size of the lower meatus. The ostium of the naso-lachrymal duct is located on the anterior upper portion of the lateral wall of the inferior meatus, under the inferior turbinate. The position of the ostium should be remembered so that it will not be injured in removing the lateral wall of the inferior meatus to drain the sinus maxillaris. The superior middle portion of the lateral wall of the inferior meatus, is the thinnest portion of the antro-meatal wall and is the point of election for passing the antrum trocar.

Hyperplasia of the Anterior End of the Inferior Turbinate.—Due to some irritation causing a hyperemia, a hyperplasia of the anterior end of the inferior

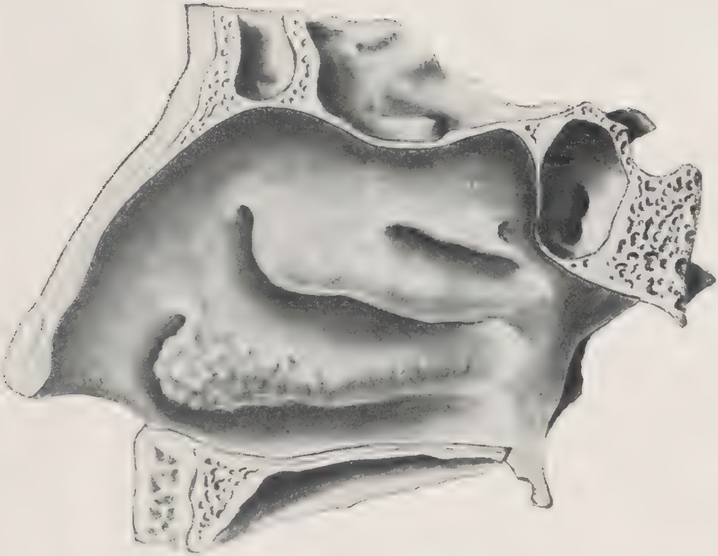

Fig. 102.—A hyperplasia of the anterior end of the inferior turbinate. It is removed with the snare. At the first sitting, one should remove only about one-half of what he thinks necessary, because of the shrinkage of the turbinate.

turbinate may occur. If this is large enough to obstruct or interfere with the passage of air, it should be removed. Only enough tissue should be removed to leave the anterior end of the turbinate normal in size. This is best performed with the snare, which avoids removing any normal bone.

Soft Hyperplasia of the Border of the Inferior Turbinate.—If, after cocainizing the inferior turbinate, it is found that the border lies on the nasal floor, the dependent portion should be removed by the cutting forceps so that it just misses the floor. It is always easy to remove a little more, so never be radical. One of the most important points to remember in reconstruction of the turbinate is not to remove too much tissue. While it would seem at first that more of the tissue could be removed, one must be extremely cautious as turbinal tissue has great shrinking power when injured. If much tissue is removed, one will be surprised, when the patient returns in a few months, to find the inferior turbinate has nearly disappeared.

It takes months to restore turbinates to their normal condition and only small amounts of tissue are to be removed at any one time, care being taken that complete healing has taken place before further corrections are attempted.

Hypertrophies and Hyperplasias of the Posterior End of the Inferior Turbinate.—Hypertrophies and hyperplasias of the posterior ends of the inferior

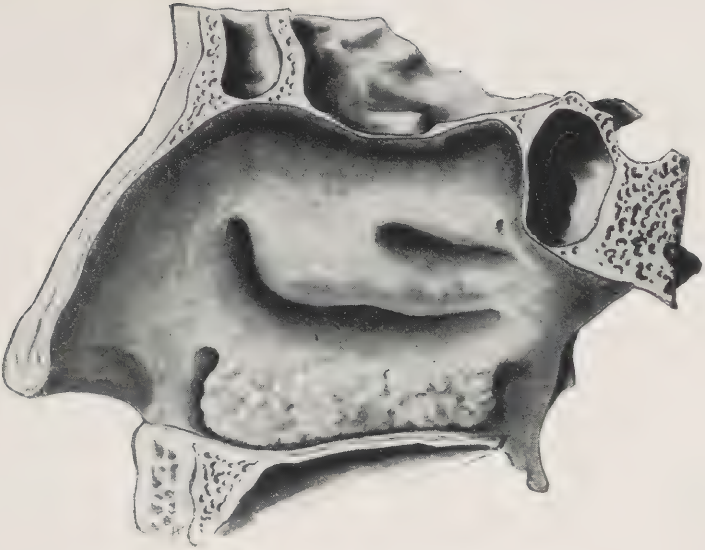

Fig. 103.—A hyperplasia of the inferior turbinate.

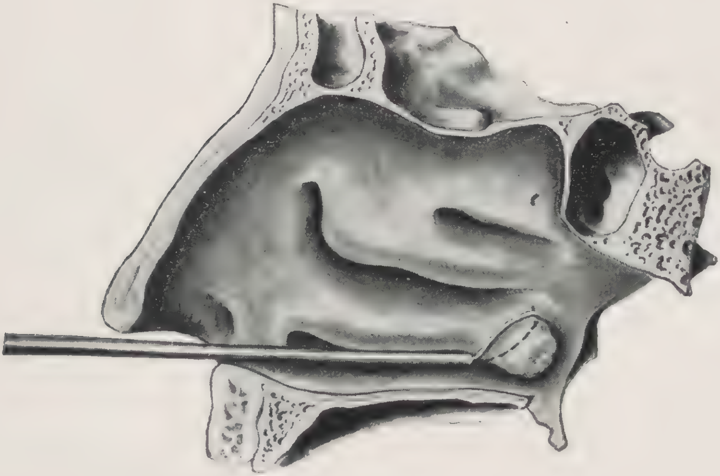

Fig. 104.—The snare removing a posterior hyperplasia of the lower turbinate.

turbinates are generally due to secretions running over them. These enlarged ends are easily removed with a snare. In anesthetizing them, as little cocain as possible should be used, as they shrink considerably under this anesthetic, and most of the growth will not be removed.

If a discharge is present the sinuses above should be opened and drained to prevent a return of the growths.

General Soft Hyperplasia of the Inferior Turbinate.—The soft hyperplasia of the inferior turbinate is due to deflection of the septum, systemic conditions or sinusitis. This hyperplastic condition can be relieved temporarily by the use of the electric cautery, but unless the irritating cause is corrected, the hyperplasia will recur.

After thoroughly cocainizing the tissue and blanching with epinephrin chlorid, one or two cautery lines are made the length of the turbinate, care being taken to burn down to the bone. The size of the hyperplasia is thus reduced and adhesions are formed, which bind the mucous membrane down to the bone. A sheet of dental wax is now placed between the septum and turbinate and retained in place a week or ten days to prevent the formation of adhesions.

Position Changing of the Inferior Turbinate.—It may be found that the inferior turbinate lies so close to the lateral wall that the opening of the naso-lachrymal duct is obstructed, causing lachryma-

Fig. 105.—The position of lines that are made by the cautery to temporarily reduce a hypertrophy of the inferior turbinate.

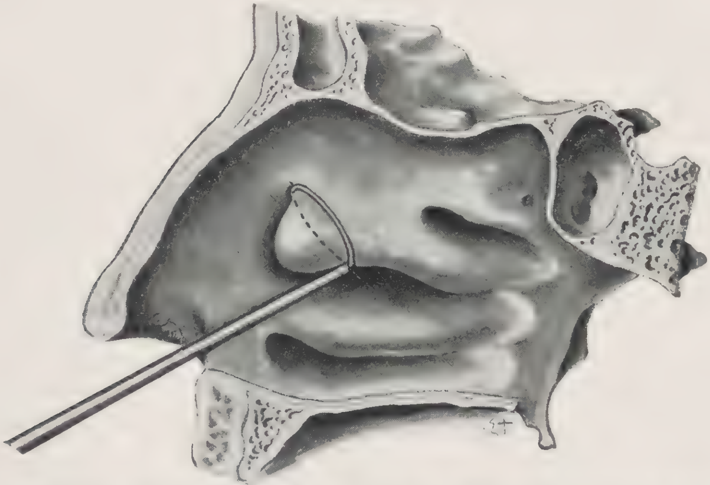

Fig. 106.—The removal of the lobulus of the middle turbinate with a snare. The scissors or chisel should not be used and only that portion removed which the snare will engage.

tion. If the bone will not break up, the anterior attachment may be cut, which will allow easy displacement. Part of a Simpson tampon is placed under the turbinate, and allowed to remain in place two days. The cut will heal and no suture is necessary.

The turbinate can be brought nearer to the lateral wall with the same technic, except that the Simpson tampon is placed between the turbinate and the septum.

Complications.—If adhesions form between the inferior turbinate and any part of the nasal fossa, they should be severed and dental sheet wax placed between the parts and allowed to remain a week or ten days until healing is completed.

THE MIDDLE TURBINATE.

The middle turbinate is not an independent bone but a large overhanging appendage of the lateral ethmoidal mass. It is covered by thick mucous membrane and erectile tissue, as found in the inferior turbinate. It consists of a short perpendicular limb and a long horizontal limb. At their meeting or knee there is frequently an enlargement or lobulus that necessitates surgical treatment. This lobulus resembles, but should not be confused with, the enlargement of this portion of the middle turbinate caused by an ethmoidal cell (cystic middle turbinate).

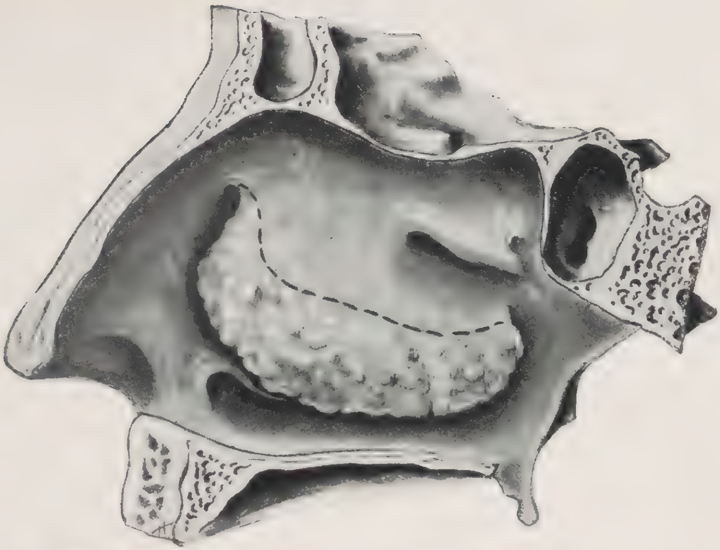

Fig. 107.—A large hyperplasia of the middle turbinate frequently present with a deflected septum. The dotted line shows the normal middle turbinate.

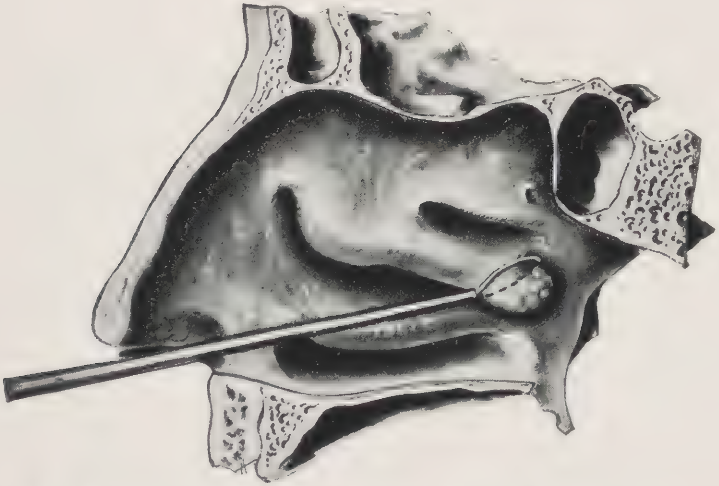

Fig. 108.—The snare removing a posterior hyperplasia of the middle turbinate. There is no danger of removing more than necessary.

which is treated in a radically different manner from the lobulus.

The attachment of the middle turbinate, starting posteriorly, follows the lower border of the superior meatus to its anterior end, then turns abruptly to the cribriform plate, curving forward to end at the agger nasi ridge.

The diagonal line of the attachment separates the anterior from the posterior ethmoidal cells. The anterior ethmoidal cells lie under the anterior superior half of the middle turbinate. The posterior inferior half of the middle turbinate is simply an "overhang".

Lobulus Operation.—At the knee of the middle turbinate we frequently have a soft hyperplasia which is easily removed with the snare. Many times when this seemingly soft hyperplasia is removed, it will be found to contain bone, and it is this enlargement of the bone that is called the lobulus of the middle turbinate. It may become so large as to interfere with the ventilation of the middle meatus, and its removal was undoubtedly the starting point of removal of the middle turbinate, on the theory that if the removal of a little was a good thing, the removal of more would be better.

If we confine ourselves to the removal only of that part over which the snare will pass, without any previous nicking or cutting of the turbinate, it is safe to say that only abnormal tissue is removed.

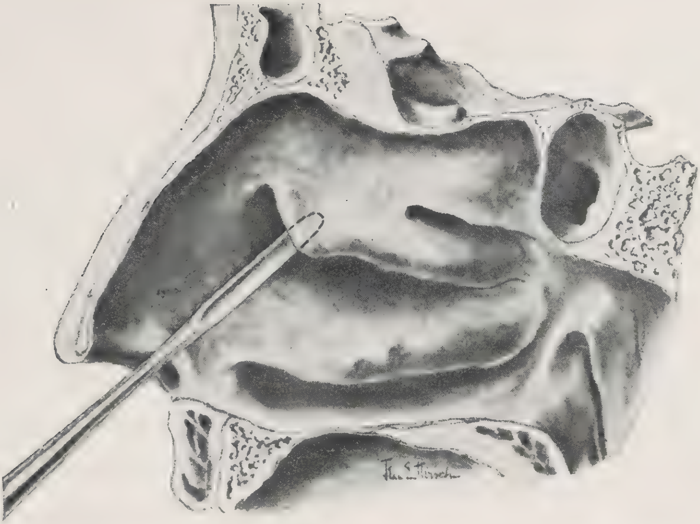

Fig. 109.—An elevator under the anterior end of the middle turbinate in an infraction of the turbinate.

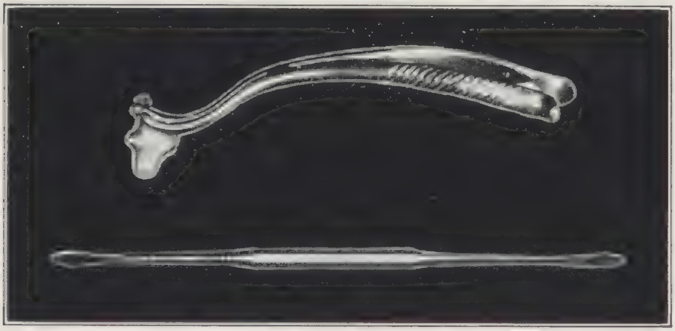

Fig. 110.—Instruments used in infraction of the middle turbinate. 1. Pynchon nasal speculum. 2. Ballenger's elevator.

Hypertrophied Lower Border of the Middle Turbinate.—In removing the hypertrophied lower border of the middle turbinate, only portions hanging below the attachment of the inferior turbinate should be removed. The biting forceps is the best instrument to use and only under vision.

Posterior Hypertrophies and Hyperplasias of the Middle Turbinate.—These hyperplasias are generally caused by discharge from the posterior ethmoidal cells running over the end of the middle turbinate. All the tissue that can be engaged by the snare should be removed. By using the snare we are less likely to injure the surrounding tissue.

Infraction of the Middle Turbinate.—The middle turbinate can only be infracted when there is space between the turbinate and the septum. The widening of the vault of the middle meatus often relieves the occluded ostia of the sinuses and restores ventilation and drainage. The anterior ethmoidal nerve is blocked and after twenty minutes, a nasal elevator is placed under the middle turbinate and the "overhang" fractured and pressed toward the septum. It may be necessary to cut the anterior attachment of the middle turbinate to attain the desired result. It is seldom necessary to place anything under the turbinate to hold it in place.

The Conchial Cell, (Cystic Middle Turbinate).—The conchial cell or the cell located in the anterior end of the middle turbinate, has every appearance of

Fig. 111.—A specimen showing an extremely large cystic middle turbinate. The entire bony overhang is one large cell.

an ethmoidal cell, being lined with the same kind of membrane. This has been known, in the past, as a diseased condition, as abscess, cyst, neoplasm, exostosis, ectasia, etc., now it is known that it is a cell, and subject to the same treatment as the other ethmoidal cells. This is particularly clear when it is known that the so-called middle, (or ethmoidal) turbinate is really an appendage of the lateral ethmoidal mass. No doubt the anlage or bud of this cell lies dormant in the middle turbinate and develops, when necessary, for the middle turbinate to enlarge enough to properly fill the space caused by a deflected septum.

In clinical work, where a compensatory hypertrophy has taken place to fill a large concavity, due to a deflected septum, not only is there a cystic or cellular turbinate, but all the cells of the ethmoidal capsule on this side have enlarged. On the opposite side of the same nose the reverse is true. The turbinate has atrophied and all the ethmoidal cells show compensatory atrophy.

Operation on the Cystic Middle Turbinate.—The middle turbinate, being part of the ethmoid capsule, occasionally has ethmoidal cells in its substance. These cells, when present, are evaginated from the lateral wall and open into the middle meatus. They are generally in the anterior part of the turbinate where the upper and lower legs meet, at a point which is called the knee. It is at this point that

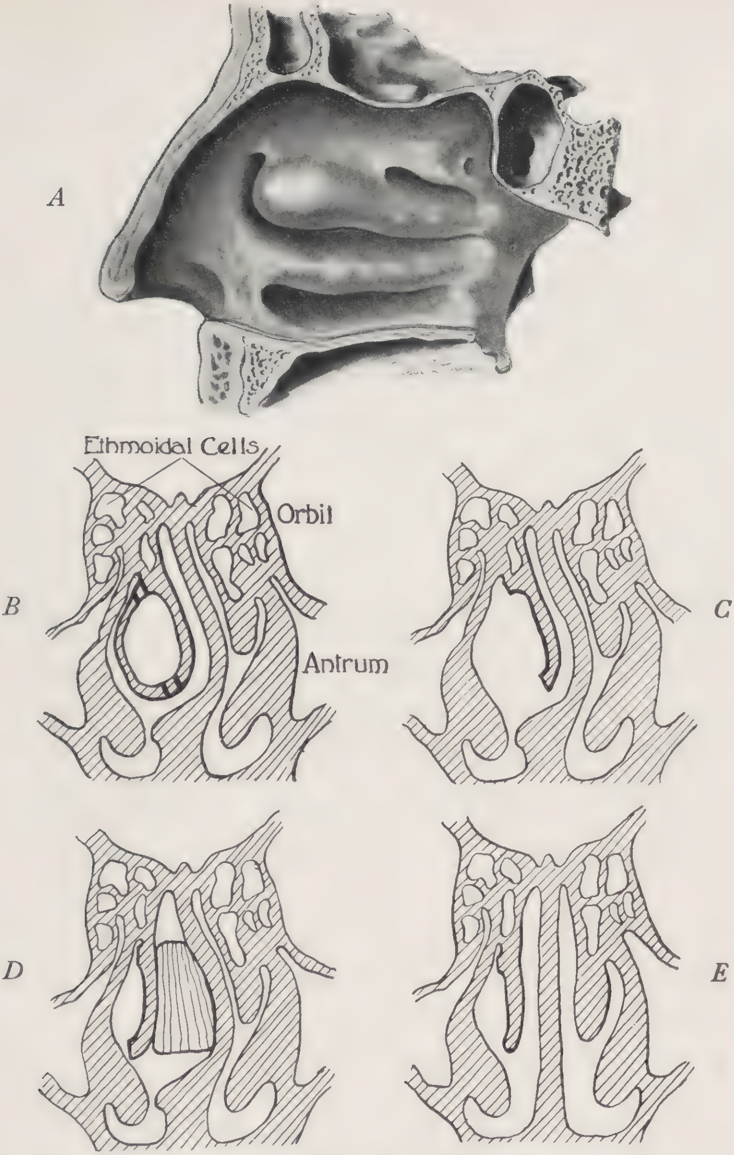

Fig. 112.—The different steps in the operation for the reduction of the cystic middle turbinate. *A* shows a medium sized cyst, which occupies the anterior half of the middle turbinate. *B*, the projecting end of the middle turbinate has been snared off, opening the cyst. The forceps has bitten out above and below to indicate portion to be removed. *C* shows the lateral thin wall of the cyst has been removed. *D*, the middle turbinate has been broken over and is held in position by a Simpson splint, placed between the middle turbinate and the deflected septum. *E* shows the submucous operation has been performed and the nasal spaces normal.

we have our lobuli and soft anterior hyperplasias. These cells occupy not only the knee but can run backward, filling the entire "overhang" of the middle turbinate.

The size of the cells usually depends upon the amount of nasal deflection, and are present only when there are large spaces to fill and are therefore compensatory. It will be found on study of the ethmoidal cells in general, that their size depends upon the amount of space to be occupied to maintain a definite distance between the mucous membrane surfaces of the septum and turbinates. It is nature's method of compensation in endeavoring to form a physiological nose. It is this attempt to correct the spacing in a nose with a deflected septum, that causes partial or complete stenosis of the ostia of the sinuses and paves the way for sinusitis, either congestive, hyperplastic, or suppurative.

The cystic middle turbinate operation should be performed before the submucous resection of the septum, as it gives the firm surface of the septum to pack against when the middle turbinate is placed in its new position.

The nasal speculum, cutting forceps and snare are the instruments usually needed in this operation. The turbinate is anesthetized by blocking the nerves from the spheno-palatine ganglion and anterior ethmoidal nerve with cocain swabs, leaving them in place from twenty to thirty minutes. The cystic

Fig. 113.—Instruments used in operation on the cystic middle. 1. Pynchon nasal speculum; 2. Sajous nasal snare; 3. Gruenwald No. 3 cutting forceps.

middle turbinate generally has a lobular deformity, which, when snared off opens the cyst. If there is no deformity, but simply a large turbinate, the cutting forceps will, as a rule, easily break into the cyst; but should it be too dense, some sharper instrument, such as a chisel, will make a point of entry for the cutting forceps. The point of entry should be in the lateral half of the anterior end. It will be seen on opening the cyst, that the lateral wall is extremely thin and it should be bitten away, leaving the heavier mesial wall to become the future turbinate.

As the cyst is lined by mucous membrane, the turbinate is soon well. It is surprising how soon it will thicken and return to form. If the ethmoid is diseased, the exenteration of the ethmoid is continued at this point; otherwise, the turbinate is broken toward the lateral wall and packed in this position, with a Simpson's tampon. The packing is removed in two days and re-applied if necessary.

Many times when the concavity in the septum extends very high, the whole anterior portion of the ethmoid capsule is so enlarged that it is impossible to move the middle turbinate over far enough to allow the membrane of the septum to hang straight after a submucous operation. It will then be found necessary, whether the ethmoidal cells are diseased or not, to perform an anterior ethmoidal exenteration before the turbinate can be broken over. With so

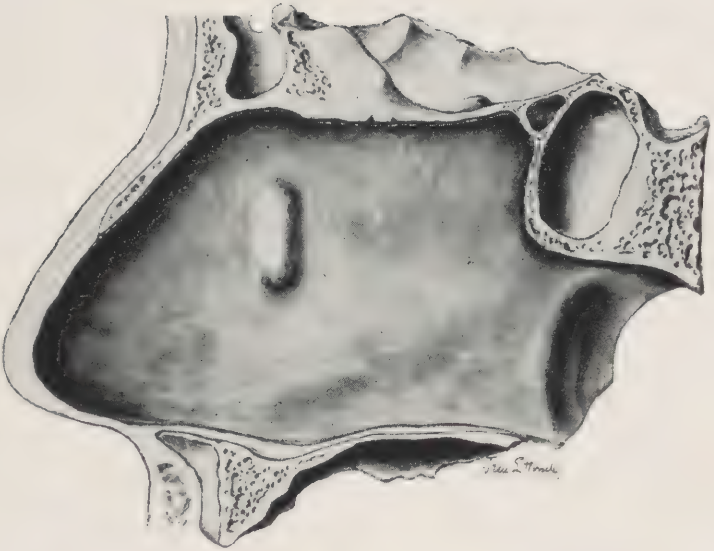

Fig. 114.—The position of the compensatory growth on the septum, at about the position of the septal tubercle.

little destruction and with perfect drainage, there is only slight reaction. The cavity is treated for some time and when completely healed, the turbinate is fractured and placed in its proper position. It may be found necessary to cut the attachment backward a short distance to break the turbinate over, but this heals at once.

THE SUPERIOR TURBINATE.

The superior turbinate calls for no surgical interference, it being only the mesial wall of the posterior ethmoidal cells. These posterior cells are opened and drained by way of the anterior ethmoidal cells, under the middle turbinate and so the superior turbinate is not disturbed.

COMPENSATORY NASAL GROWTHS.

Nature compensates in every part of the body where parts are malformed, and strives to make the condition as workable as possible. This fact is beautifully shown, not only in the compensatory hypertrophy and atrophy as stated above, but also by the compensatory soft growths found on the lateral wall of the nose and on the septum, following removal of the turbinates and in cases of cured atrophic rhinitis. A number of years after the middle turbinates have been removed, to exenterate the ethmoidal sinuses, or when disease has destroyed these structures, growing out from different por-

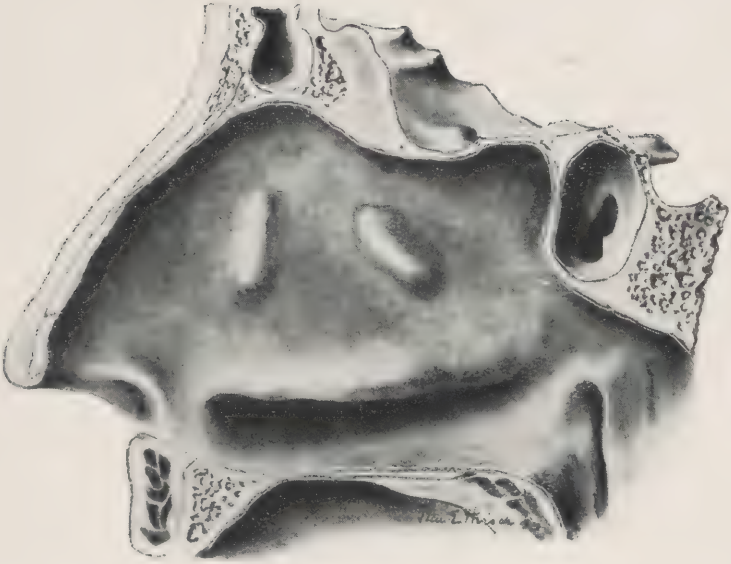

Fig. 115.—The position of the anterior and posterior compensatory growths on the lateral wall. In the drawing the middle and superior turbinates and their markings have been blanked out to show more clearly the position of these growths.

tions of the lateral wall or on the septum are soft, meaty growths of a hyperplastic nature, looking very much like turbinal tissue.

The position of the growths with the physiological protection they give to the nose, demonstrates their compensatory character.

They are found on the septum at about the position of the septum tubercle and are undoubtedly a hyperplasia of this tissue.

On the anterior part of the lateral wall, these growths begin at the anterior attachment of the middle turbinate, following the anterior edge of the uncinate process and seem to be a hyperplasia of the tissue covering the uncinate process. In this position they protect in a measure the frontal sinus opening, the infundibular and bulla regions, which are normally covered by the middle turbinate.

The posterior growths on the lateral wall are along the posterior half of the attachment of the middle turbinate and protect the posterior ethmoidal and sphenoidal regions from irritating air currents.

These growths, placed by nature in trying to compensate for the loss of the middle turbinates, are argument enough against the removal of these important structures.

If these growths become so large as to cause obstruction, the electric cautery only should be used to reduce their size. One or two deep cautery lines through them will be sufficient.

CHAPTER XII.

The Ethmoidal Cells.

DESCRIPTION.

The ethmoidal capsule (ethmoidal mass), containing the ethmoidal cells is bounded above by the fronto-orbital plate, laterally by the orbit, medially by the mesial wall of the middle and superior turbinates and inferiorly by the vault of the middle meatus. It extends from the posterior edge of the nasal process of the maxillary bone anteriorly, to the sphenoidal sinus posteriorly. The mesial wall extends down as an "overhang" of the ethmoidal capsule, and is what we see and know as the middle turbinate. This "overhang", or middle turbinate not only gives off moisture and heat to the inspired air, but protects the structures in the upper part of the middle meatus.

EMBRYOLOGY OF THE ETHMOIDAL CELLS.

The ethmoidal cells (cellulæ ethmoidalis) are developed by evaginations of the nasal mucous membrane from the middle, superior and first supreme nasal meati, or their accessory furrows and recesses. These out-pouchings are in evidence as early as the one hundred and twentieth day. The evaginations

soon enlarge to tubular-like sacs, the ostia of which are at the point of initial growth, and at full term, the cells correspond in number, but not in size, to those in the adult.

As the lateral masses of ethmoidal capsules enlarge with the growing head, the cells increase in size until they honeycomb the ethmoidal capsules. Those cells that are evaginated from, and eventually empty into the middle meatus, are called the anterior ethmoidal cells. Those cells that are evaginated from or empty into the superior and supreme meati are called the posterior ethmoidal cells. While they may overlap or extend in other directions, they are named according to the location of their ostia.

ANATOMY OF THE ANTERIOR ETHMOIDAL CELLS.

The anterior ethmoidal cells are divided into groups according to their location.

AGGER NASI CELLS.

The naso-turbinal (agger nasi), the prominence just above and anterior to the anterior attachment of the middle turbinate, contains the agger nasi ethmoidal cells. Some operators open these cells to make a passage to the frontal sinus or start the exenteration of the ethmoidal cells at this point.

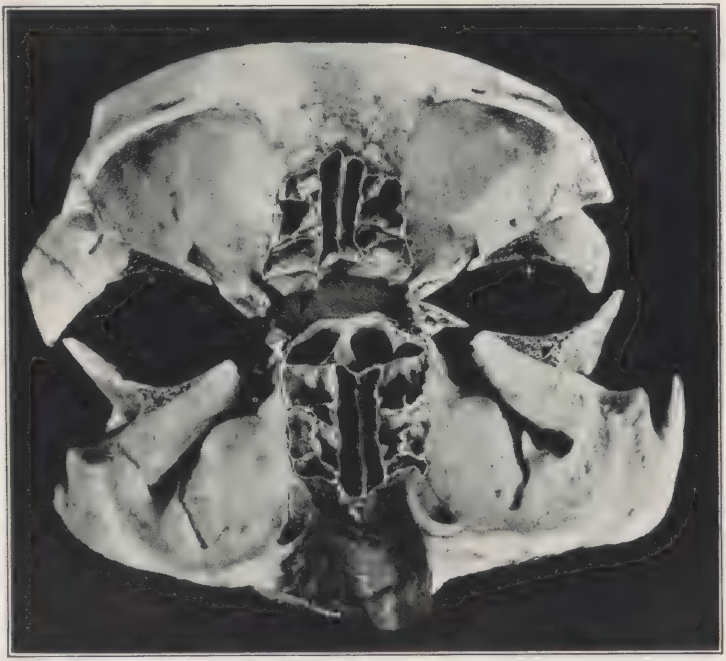

Fig. 116.—A specimen cut horizontally just below the roof of the ethmoidal capsule and lifted up. The portion shows the cribriform plates separated by the septum. On either side of the cribriform are seen the roofs of the anterior and posterior ethmoidal cells and the sphenoids. In the lower portion, the different ethmoidal cells and sphenoid sinuses are distinguishable.

INFUNDIBULAR ETHMOIDAL CELLS.

Posterior to these cells, but near the lateral wall, and opening into the infundibulum directly or indirectly, are the infundibular ethmoidal cells, varying in number from one to four.

FRONTAL RECESS ETHMOIDAL CELLS.

Mesially from the infundibular ethmoidal cells lie two or three cells called the frontal recess ethmoidal cells, opening as they do into the frontal recess.

BULLA ETHMOIDAL CELLS.

Posteriorly from these cells and following along the vertical portion of the middle turbinate attachment, are the bulla ethmoidal cells, their ostia opening into the bulla recess and then into the middle meatus. This last group, the bulla ethmoidal cells, are sometimes known as the middle ethmoidal cells, (cellulæ ethmoidalis mediæ), and are from one to four in number.

One should remember that the infundibular and frontal recess ethmoidal cells are side by side, and it is from one of these groups that the frontal sinus is formed.

The anterior ethmoidal cells are therefore made up of four groups, the agger nasi cells, the infundibular cells, the frontal recess cells, and the bulla cells. A homely explanation would liken these groups

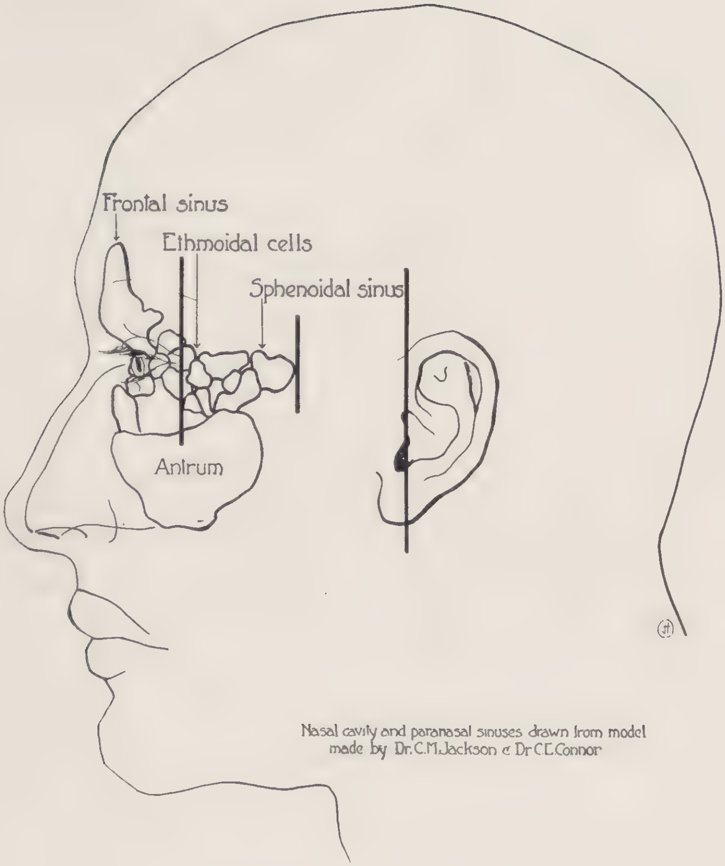

Fig. 117.—The position of the nasal sinus, if seen transparently through the head.

to a team of horses, a wagon, and one lead horse. The lead horse represents the agger nasi cells, the team of horses represents the infundibular and frontal recess cells, which are side by side, and the wagon represents the bulla cells; the whole outfit representing the anterior ethmoidal cells.

ANATOMY OF THE POSTERIOR ETHMOIDAL CELLS.

Posterior to the vertical portion of the attachment of the middle turbinate, lie the posterior ethmoidal cells, which arise from the superior and supreme meati. There are generally two cells opening into the superior meatus, and one in the supreme meatus when it is present. It is this latter cell that sometimes occupies the space in the sphenoid bone above the sphenoidal sinus, and is known as the ethmo-sphenoidal cell. These posterior cells are very rambling, they may extend down into the antrum (ethmo-maxillary cell), toward the orbit (ethmo-orbital cell), toward the frontal bone (ethmo-frontal cell), or toward the sphenoid (ethmo-sphenoidal cell).

THE ETHMOID CAPSULE.

The measurements of the ethmoid capsule vary in the new-born to the adult from ten to forty millimeters in length, eight to thirty millimeters in height, four to fourteen millimeters in width. It occupies

Fig. 118.—The marking on the side of a head, a skull and the lateral half of a skull, which gives the external measurements for the location of the posterior wall of a normal sphenoid. A perpendicular line is drawn at the temporo-orbital edge. Also a perpendicular line is drawn through the external auditory meatus. A third perpendicular line is drawn half way between these two lines and marks the posterior wall of a normal sphenoidal sinus. During an operation, one can place his finger on the Gruenwald forceps or the curette at the tip of the nose, remove the instrument and place it along the side of the face to tell its location in the nose. If the end of the instrument is in front of the first line, it is in the anterior ethmoids. If between the first and second lines, it is in the posterior ethmoids, or sphenoids. If behind the second line, it is in an abnormally large sphenoid. The anterior ethmoids are situated anterior to the line drawn through the temporo-orbital edge. The posterior ethmoids and sphenoid are situated between the anterior and middle perpendicular lines.

the space anterio-posteriorly from a perpendicular line drawn through the frontal sinus to a similar line drawn through the anterior wall of the sphenoid, superior-inferiorly from the cribriform plate to the lower border of the uncinate process, and horizontally from the naso-orbital wall to the nasal fossa. There is an ethmoidal capsule in each nasal fossa. They are separated completely by the septum. Anatomists speak of them as the ethmoid capsule or labyrinth, because they are situated in the ethmoid bone. It is preferable to speak of them as single capsules, because they are diseased as single capsules and are operated upon as single capsules.

ETHMOIDITIS.

Ethmoiditis is divided into an acute and a chronic stage.

ACUTE ETHMOIDITIS.

In the acute stage, there are acute catarrhal and suppurative inflammations.

Acute inflammations are coryzas involving the sinuses.

Resolution is slow or rapid, depending on anatomical conditions. There must be proper ventilation and drainage for rapid recovery.

If the catarrhal inflammations progress, a purulent stage is reached, and as drainage and ventilation are interfered with, recovery is slow. It may

Fig. 119.—The lines on the face, the skull and a coronal section that mark the position of the cribriform plate, the ethmoid capsule and the entrance to the frontal sinus. A horizontal line is drawn through the internal canthus and marks the level of the cribriform plate. A perpendicular line is drawn through the center of the nose and marks the position of the normal septum. A perpendicular line is drawn through the internal canthus of the eye and marks the normal lateral limits of the nasal cavity. A dotted perpendicular is drawn to the nasal side of the center between the two perpendicular lines. That portion of the horizontal line between the dotted line and the central perpendicular line shows the limits of the cribriform plate. The space between the dotted line and the external perpendicular line shows the space occupied by the ethmoid capsule and the entrance to the frontal sinus.

be necessary to operate in this stage to relieve pressure and pain.

If the first immunity has been established, there is no more danger of opening the ethmoidal capsule, if the middle turbinate is left in place, than there would be in opening the mastoid under the same condition.

The same palliative treatment should be used after operative interference in acute suppurative ethmoiditis as would be used in unoperated cases.

CHRONIC ETHMOIDITIS.

There are three types of chronic ethmoiditis, hyperplastic, empyemic and suppurative.

HYPERPLASTIC ETHMOIDITIS.

In hyperplastic ethmoiditis, there is an increase of tissue, and polypi may be present. In the chronic state, the secretion is thin and watery, but frequent secondary infections give rise to purulent discharges. The hyperplastic and suppurative stages are so overlapped that they are difficult to distinguish. The treatment being the same (exenteration), the exact diagnosis is immaterial. The symptoms of pain, suppuration and obstructed breathing are the ones to be relieved, and the establishment of as near a normal nasal passage as possible should be made.

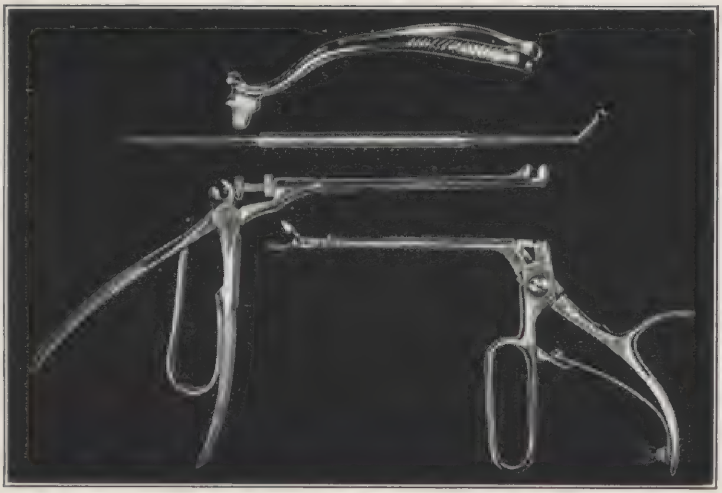

Fig. 120.—Instruments used in exenteration of the ethmoids under the middle turbinate. 1. Pynchon nasal speculum; 2. Pratt double end ethmoid curette; 3. Hajek sphenoid punch (adjustable); 4. Gruenwald No. 3 biting forceps in a universal handle.

EMPYEMIC ETHMOIDITIS.

Empyemic ethmoiditis is a closure of the ostia of one or more cells with an accumulation of pus within the cells. Its cure is an exenteration of the cells.

SUPPURATIVE ETHMOIDITIS.

Suppurative ethmoiditis is characterized by a chronic purulent discharge from the sinuses. The discharge varies in consistency from time to time, depending upon re-infections. As a rule there is no pain except during acute re-infections, where the drainage is more interfered with.

It is in the suppurative stage that polypi are found, due to the irritating discharge. This stage, especially in children and young adults, is probably often the forerunner of atrophic rhinitis.

MUCOCELE OF THE ETHMOID.

Mucocele of the ethmoid is the closure of the ostium of a mucus cell, with an accumulation of the mucus produced in the cell. If the contents become infected, it becomes empyemic. Its cure is exenteration.

INTRANASAL EXENTERATION OF THE ETHMOIDS.

To perform an exenteration of the ethmoids without removing the middle turbinate, it is necessary to know the anatomy perfectly and to be able to visualize exactly.

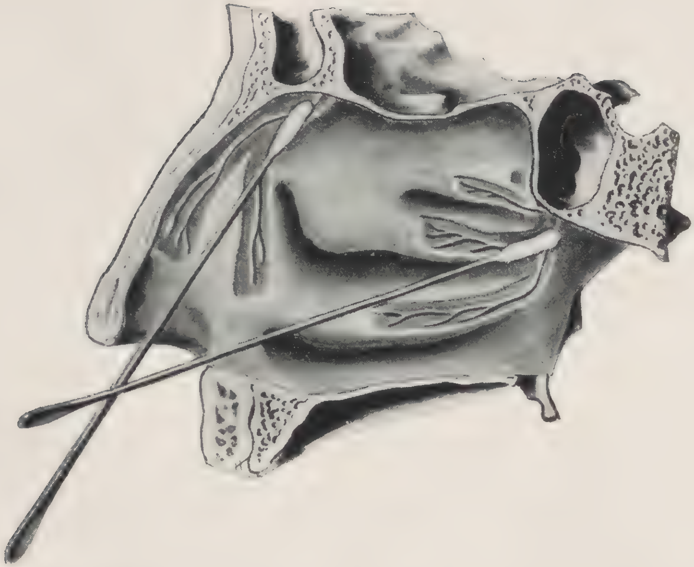

Fig. 121.—The position of the cocain swabs in anesthetizing the nasal ganglion and the anterior ethmoidal nerve. The swabs are wound on wooden applicators dipped in 1 : 1000 epinephrin chlorid and rolled in cocain powder. The swab for the nasal ganglion is pressed backward along the lower edge of the middle turbinate to the posterior wall of the nasal fossa, hugging the lateral wall. It is under this point in the spheno-maxillary fossa that lies the nasal (Meckel's) ganglion. The swab for the anterior ethmoidal nerve is passed just in front of the anterior attachment of the middle turbinate, straight up to the vault of the nasal fossa. The swabs are allowed to remain twenty minutes and will anesthetize the lateral wall and septum of the nose.

To protect the middle turbinate in exenteration of the ethmoids, it is necessary to have a nasal space of five millimeters when the tissues are thoroughly contracted. If this space is not available, a submucous resection of the septum must be performed. Polypi, lobuli and soft hyperplasia of the anterior end of the middle turbinate, that the snare can engage should be removed. If there is a cystic middle turbinate present, the operation for the cystic middle turbinate should be performed before the exenteration.

MEASUREMENTS.

There are three anatomic points which should be kept in mind:

First, we can roughly measure the posterior wall of the sphenoid by marking a line on the temple, half way between the temporo-orbital edge and the bony auditory orifice. This line marks the posterior wall of the normal sphenoid.

Second, the temporo-orbital edge marks the posterior limit of the anterior ethmoidal cells. With these known points, and knowing the average anterio-posterior measurements of the ethmoidal cells and sphenoidal cell, we can, by internal and external measurements during the operation, easily tell just where we are in these important structures.

Third, the inner canthus of the eye is on a level with the cribriform plate and is also the position of

Fig. 122.—In opening the anterior ethmoidal cells, the head is tipped back. The top of the open blade of the instrument, if it could be seen, would be on a line with the inner canthus of the eye, under the edge of the middle turbinate. The progressive action is then directly backward until you reach the attachment of the middle turbinate.

the superior border of the internal orbital plate (lamina papyracea); we have this external point to judge our directions when we break into the anterior ethmoid.

OPERATION.

The instruments necessary for the operation are a Pynchon nasal speculum and a pair of nasal cutting forceps, (Gruenwald, Myles, Hartmann), with a fenestrated blade five millimeters wide, which is about one-half the width of a normal ethmoid capsule. The forceps with the universal handle is the best, because the lower lip of the blade is stationary, and you can place it just where you wish to cut, and have no pulling back in its action. A Pratt double end cup-shaped curette, twenty-two centimeters long, with one end bent at an angle of forty-five degrees, about two centimeters from the end, the cup in the angled end to be fenestrated. The cup on the straight end should be one millimeter shallower than the angled end, which gives it a sharper point to more easily open into the ethmoid capsule when necessary. A right angled cutting forceps is frequently necessary to cut soft tissue from the lateral wall. A sphenoidal punch is very satisfactory for this instrument. There should be plenty of cotton wound nasal applicators. Every surgical precaution should be taken in preparation for the operation.

The anesthesia (blocking of the anterior ethmoidal nerve and the spheno-palatine ganglion), is

Fig. 123.—On opening the posterior ethmoidal cells, the head is tipped forward to nearly a horizontal position, and the instrument follows back along the roof of the frontal bone. A slightly more forward dip, and then directly backward and we pass through the anterior wall of sphenoidal sinus. The opening into the sphenoidal sinus should be made by a sharp-ended curette. The straight end of the Pratt ethmoid curette was made for this purpose as the shape and thickness of the bowl gives the forward point a sharp edge.

used as in the submucous resection of the septum, with the addition of a small pledget of cotton dipped in a ten per cent. cocain solution, made with epinephrin chlorid, placed under the anterior end of the middle turbinate. Only the side to be operated should be anesthetized.

The patient is placed in a sitting position with the head thrown well back. Looking into the nose the anterior attachment of the middle turbinate is just below the visual line to the internal canthus. The open cutting forceps are placed under the middle turbinate with the upper blade just under the anterior attachment and pressure made on a line with the internal canthus. Breaking into the anterior ethmoidal cells, biting backward and upward as long as there is any soft bone encountered. The anterior ethmoidal cells are always in this position. The straight end of the Pratt curette can be used for the initial opening, if desired.

We now reach a heavy wall, at least four times thicker and stronger than the partition between the anterior ethmoidal cells. This wall is the attachment of the middle turbinate as it turns upward toward the cribriform plate at the anterior end of the superior meatus, and is the posterior wall of the anterior ethmoidal cells, and of course, the anterior wall of the posterior ethmoidal cells.

To exenterate the posterior ethmoidal cells, it will be necessary to break through this wall. If it re-

Fig. 124.—The straight end of the Pratt curette is shown in the anterior ethmoidal cells under the middle turbinate. The shaft of the curette is parallel with the bridge of the nose and pointing directly at the internal canthus. The curette is grasped by the handle as one would hold a pen. It gives perfect control over the instrument and all the force required can be applied.

quires too much force in using the cutting forceps, the straight end of the Pratt curette with its sharp edge will easily accomplish the result. Progressing backward into the posterior ethmoidal cells, the head is now brought forward so as to follow along the line of the fronto-orbital plate.

With a mental picture of the ethmoid capsule, bounded as it is on the orbital side by the lachrymal bone and the ethmo-orbital plate (lamina papyracea), nasally by the middle turbinate, superiorly by the fronto-orbital plate and posteriorly by three-fifths of the anterior wall of the sphenoidal sinus, take the straight end of the Pratt curette and with a firm but gentle stroke in every direction, curette out all soft tissue. If the tissue is firm, smooth and yielding under the curette on the orbital side, it it shows that we are down to the periosteum of the orbit, and further curetting should not be done on this side.

The anterior ethmoidal and agger nasi cells are removed with the angled end of the Pratt curette, curetting in an arc form toward the tip of the nose, removing the anterior cells and enlarging the space upward toward the frontal sinus. Now cut out the floor of the capsule (which consists of the lower part of the bulla, the posterior attachment of the middle turbinate, and floor of the posterior ethmoidal cells), back to the sphenoidal sinus, giving free drainage under the entire length of the middle turbinate.

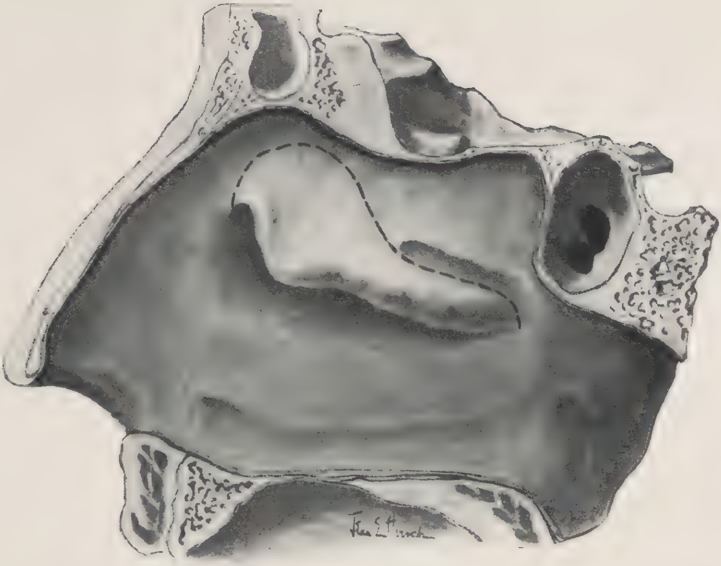

Fig. 125.—The attachment of the middle turbinate. This must be understood to make the ethmoid operation clear.

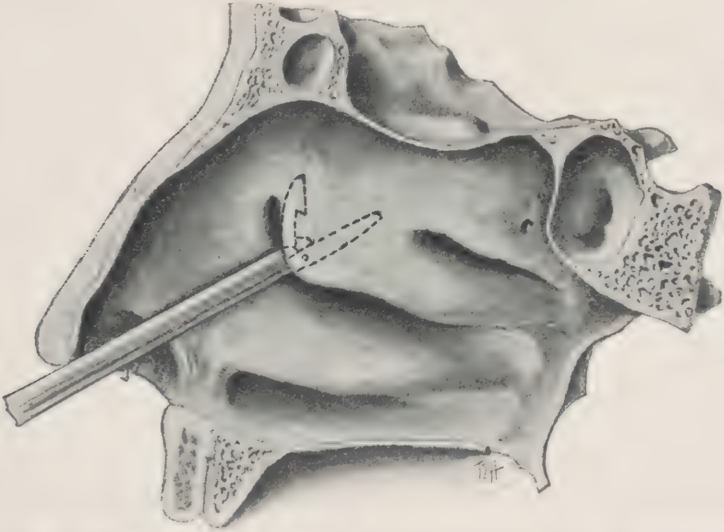

Fig. 126.—The Gruenwald biting forceps breaking into the anterior cells just under the anterior attachment of the middle turbinate.

The middle turbinate (or mesial wall of the ethmoid capsule), is now hanging from its roof attachment and separates the exenterated cavity from the cribriform plate. With this middle turbinate in position, it is impossible for an operator, if careful, to enter any dangerous area. The orbital plate is on the temporal side, the turbinate on the mesial side, the hard fronto-orbital plate above and the anterior wall of the sphenoid posteriorly.

There is little bleeding owing to the fact that neither the anterior nor posterior ethmoidal nor the spheno-palatine arteries are cut, unless there are anomalies of these arteries present. If there is bleeding, or oozing that does not stop in a short time, this bony cavity can be gently but firmly packed with medicated gauze and allowed to remain for twelve hours.

Usually the cavity under the turbinate is not packed, but a finger-shaped piece of cotton is placed in the middle meatus back to the anterior end of the middle turbinate and the patient is allowed to go home, with the instructions to return the next day to have the cotton removed. The home treatment consists of dropping, with a short nosed dropper, a few drops of nasal oil into the nostrils three times a day, which is applied by having the patient in the supine position with the head well back and down. As the medicine is dropped into the nostril the patient is to sniff forcefully.

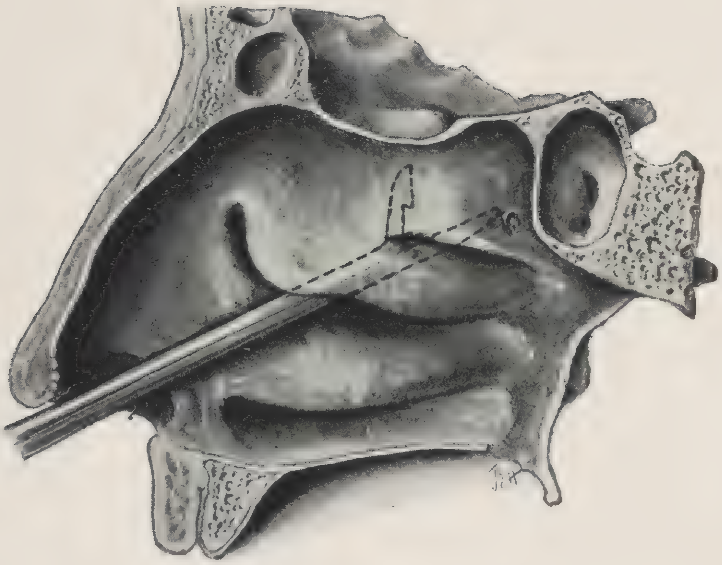

Fig. 127.—The Gruenwald forceps progressing backward and opening the posterior ethmoidal cells.

On the third day, after cocainizing and cleaning the nose, the cavity under the middle turbinate is swabbed with iodin-glycerin solution, (3 per cent. tincture iodin in glycerin). The patient should return within one week after the three day treatment and then each week or two, as it will frequently be found necessary to bite away granulations to keep the cavity clear and healing properly. In a short time it is almost impossible to detect that the nose has been operated upon. When the cavity is properly healed, it will be lined with mucous membrane and have the same appearance as the rest of the nose. If, after a suitable length of time, the discharge does not cease, the nose can be re-cocainized and the operation easily extended to the frontal, sphenoidal or any adjacent cells that may have been overlooked.

COMPLICATIONS.

No force should be used with the curette when it is found that the os planum or orbital plate is gone and the periosteum exposed. In removing the posterior portion of the floor of the capsule, one may open an anomalous branch of the spheno-palatine artery, but there are firm walls to pack against, so the bleeding can easily be controlled.

The patient should be warned against blowing the nose with one or both nostrils closed, either during or after the operation because, if a portion of the

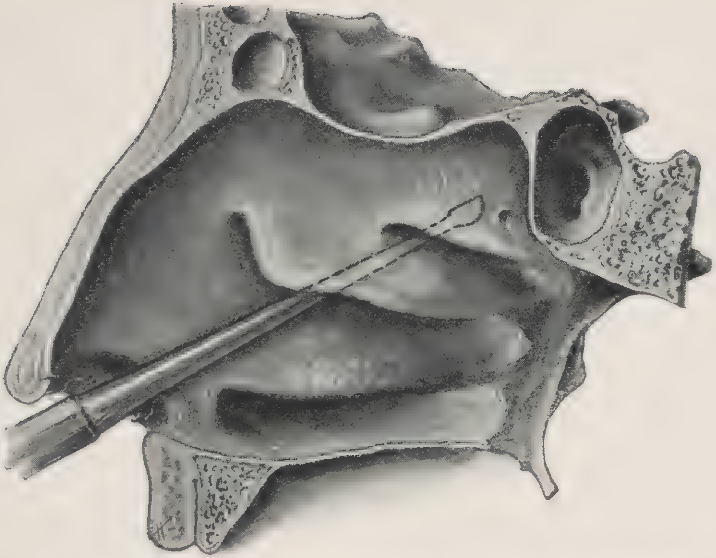

Fig. 128.—The Pratt ethmoid curette in the posterior ethmoid cells after the biting forceps has removed all the soft tissue. The bony capsular walls of the anterior and posterior cells are gently curetted in all directions.

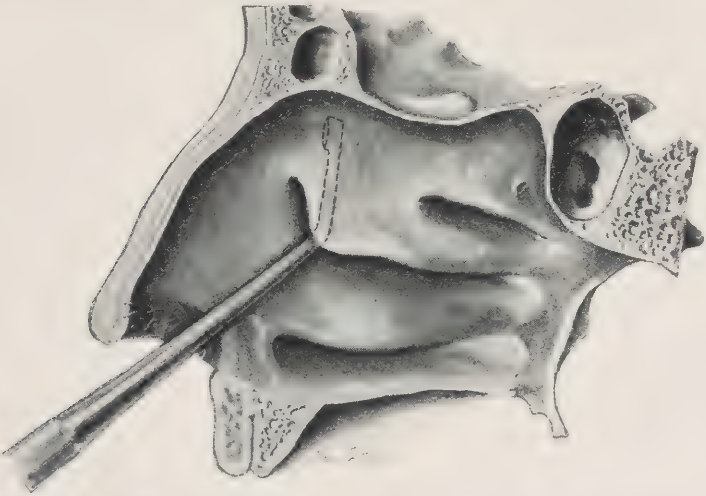

Fig. 129.—The angular end of the Pratt ethmoid curette in position. Curetting the anterior ethmoid, and agger nasi cells from the floor of the frontal sinus.

lachrymal bone has been removed, air may be blown into the tissue of the lids, forming an emphysema. If this occurs at the time of the operation, place a large piece of wet cotton over the closed lids and then gently but firmly press backward with the hand. This, in most cases, will express the air. A firm bandage placed over the eyes will prevent further trouble.

Patients should always be instructed not to blow the nose but to "hawk" back in clearing the nose after a nasal operation, or during a nasal infection, to prevent discharge and blood being inflated into the ears.

If blood extravasates into the tissues around the eye lids, it should be treated as a "black" eye, with hot applications.

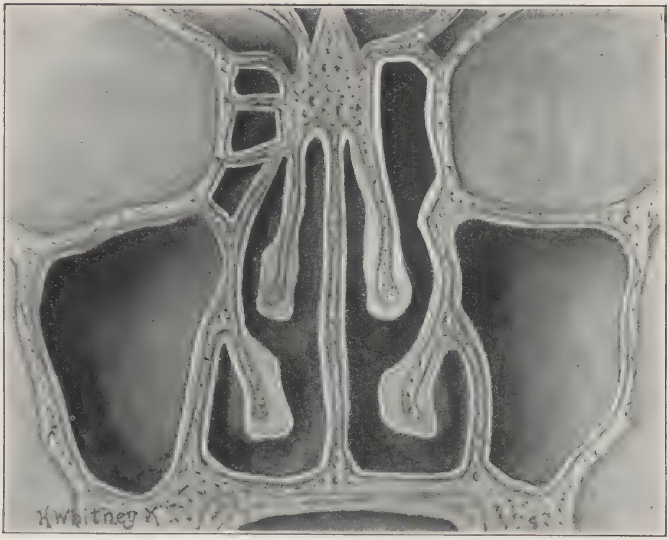

Fig. 130.—A cross section showing an operated ethmoid.

CHAPTER XIII.

The Sphenoidal Sinus.

THE sphenoidal sinus primarily arises from the upper posterior limits of the nasal fossa. It is not evaginated into the wall as are the other sinuses, but is constricted off from the posterosuperior portion of the nasal fossa and lies against the sphenoid body. The pouch is demonstrable about the fourth month of fetal life. No portion of the fetal sphenoidal sinus is within the sphenoid bone. It is not until after birth that the sinus is enclosed into the sphenoid bone by resorption.

The ostium of the sinus is at the point where the sinus is constricted off from the nasal fossa, and always opens into this fossa above the superior meatus, at a point called the spheno-ethmoidal recess.

The sinus sometimes develops quite rapidly in childhood, so that at the third year, if it becomes infected, there may be a trigeminal neuralgia from its intimate relationship with the ophthalmic and maxillary nerves.

As early as the sixth year, there may be an irritation of the Vidian nerve by the proximity of the pterygoid canal to the floor of an inflamed sphenoidal sinus.

The adult normal sphenoidal sinus occupies the anterior half of the central portion of the sphenoid bone and varies in shape and size. It may, at times, occupy the entire body of the sphenoid bone.

It is always separated from its fellow sinus by a partition which usually runs in a general antero-posterior direction.

The sinus may ramify by absorption into the lesser wings of the sphenoid, the clinoid process, the palate bone and even affect neighboring structures.

It is possible that all the paranasal sinuses may become one cavity by absorption of their contact walls. This is known to be true between the posterior ethmoidal and sphenoidal sinuses.

The spheno-palatine fossa with its contained nasal (Meckel's) ganglion is in close proximity to the ethmoidal and sphenoidal sinuses, they being posterior and above. The ganglion is continually subjected to irritation from diseases of these sinuses.

THE SYNDROME OF THE NASAL GANGLION NEUROSIS.

It is to Dr. Sluder that we are indebted for our intelligent working knowledge of the nasal ganglion (Meckel). This ganglion is particularly interesting, not only for its explanation of previously hidden neurosis, but also because it can be so thoroughly and easily cocainized for intranasal operations.

The ganglion is situated in the spheno-maxillary fossa, just under the end of the posterior attachment of the middle turbinate. Anterior to the spheno-maxillary fossa lies the maxillary antrum, and posterior and above, the ethmoidal and sphenoidal sinuses. Any inflammation of these sinuses may affect the nasal ganglion. The roots and branches of this ganglion are so widely connected and distributed, that when it is inflamed, the whole head, neck, shoulders and arms radiate pain. Together with these radiating pains are frequently all the symptoms of hay fever.

These symptoms vanish as if by magic by simply anesthetizing this ganglion. It is easily done by the use of cocain mud on swab applicators over the region of the ganglion. If anesthetizing the ganglion relieves the pain, the sinuses should be looked into carefully to clear up any inflammations which might cause the irritation. Undoubtedly nearly every case of irritation is due to sinus inflammation.

If the sinuses appear clear and the pain continues, an application of silver nitrate (2 to 50 per cent.) over the spheno-palatine foramen should be tried. The radical treatment, which must be used in some cases, is to inject the ganglion or completely destroy it.

Not infrequently a posterior ethmoidal cell grows into the body of the sphenoid bone at the expense of the sphenoidal sinus. This rambling cell is the

Fig. 131.—Instruments used in opening the sphenoid. 1. Pynchon nasal speculum; 2. Pratt ethmoid curette; 3. Schmithuisen sphenoid biting forceps (adjustable); 4. Gruenwald No. 3 biting forceps. 5. Washing canula; 6. 3 ounce metal syringe.

one which grows in the supreme turbinate and is known as the ethmo-sphenoidal cell. The posterior ethmoidal cells could be known as the "Ramblers" for these are the cells that form our so-called anomalies, the ethmo-orbital, ethmo-maxillary and ethmo-sphenoidal cells.

The sphenoidal sinus may be said to occupy the danger position in the skull. When well pneumatized it is in close relation with the hypophysis cerebri, the brain stem, the cavernous sinus, the optic nerve and commissure, the Vidian nerve, the ophthalmic and internal carotid arteries.

Certain of the cranial nerves related to the cavernous sinus may be paralyzed, as the motor ganglion, the trochlear, the ophthalmic, the abducens, the maxillary, the masticator and the mandibular, causing ptosis, pupil irregularities, strabismus, pain, etc. In thrombosis of the cavernous sinus, edema of the eye-lids, sides of the face and nose and exopthalmos due to obstruction of the return flow of blood.

This shows what structures inflammations of the sphenoid may affect and why one should be content with thoroughly removing its anterior wall and very lightly curette the cavity, especially the lateral wall. In nearly every case, simply enlarging the normal opening to give thorough drainage is all that is needed.

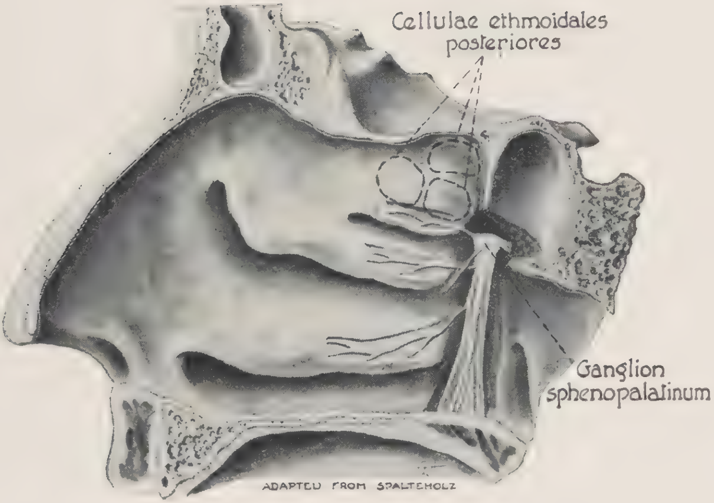

Fig. 132.—Position of nasal ganglion (Meckel's) in relation to the posterior ethmoids and sphenoidal sinus.

THE SPHENOIDAL OSTIUM.

The sphenoidal ostium is always located on the anterior wall of the sinus and empties into the spheno-ethmoidal recess. It is normally at the upper and inner third of its anterior wall, and the opening is generally hidden by the posterior end of the superior turbinate. In diseased conditions of the sphenoid sinus, its anterior wall is removed, but when the sinus is cured, the opening closes until only a normal ostium remains. While the opening seems to be in a disadvantageous position, nature has decided otherwise and insists upon retaining the original position of the ostium. For some reason, she deems it is better to have the ostium at the upper rather than the dependent portion of the sinus. If we maintained the quadruped position of our ancestors, the ostia of all our sinuses would be in the most dependent position.

SPHENOIDITIS.

An ordinary coryza, with headache radiating from the top to the side and back of the head, dizziness and restless sleep, are symptoms of sphenoid involvement. With free drainage there is very little pain but some post nasal discharge. The discharge is generally the consistency of glue and dries and adheres to the pharynx.

The pain symptoms of the occluded type are very severe, but indefinite, due undoubtedly to irritation

of the nasal ganglion. There are mental symptoms, post nasal discharge, sore throat from irritating discharges, tinnitus aurium and scintillating scotoma with headache.

Upon examination, the nose may seem apparently normal or slightly congested. There will be some post nasal secretion. Large masses of secretion accumulate over night on the pharynx, which the patient generally removes the first thing in the morning by "hawking". There may be hyperplastic masses on the sides of the septum posteriorly and also on the posterior ends of the middle and inferior turbinates. As a rule, the complaints of the patient seem greater than the appearance of the nose would warrant.

SPHENOID OPERATION.

The same instruments are used as in the exenteration of the ethmoidal cells.

It is unnecessary to remove any or all of the mesial wall (middle turbinate) to open the sphenoidal sinus. Sphenoiditis is generally accompanied with disease of both the anterior and posterior ethmoidal cells, and we gain nothing by saving these cells.

The first part of the operation is to exenterate the anterior and posterior ethmoidal cells (Chapter 12). The middle turbinate or mesial wall of the ethmoidal capsule is now hanging from its vault

attachment anchored anteriorly by its anterior attachment.

The straight end of the Pratt curette is passed under the turbinate, into the sphenoid through its ostium or its anterior wall. From time to time the external measurements should be taken on the side of the head to make sure of the position of the curette. The posterior wall of a normal sphenoidal sinus can be marked on the temple by a perpendicular line drawn one-half of the distance between the temporal edge of the bony orbit and the bony external auditory canal.

The opening is now enlarged in the anterior wall with any type of sphenoid biting forceps, and if necessary, the sinus lightly curetted on the floor, mesial wall and roof. The internal carotid artery lies near the lateral wall so one should be careful in this direction. The sinus can be wiped out and treated as often as necessary. When a cure is accomplished, it will be found that nature has closed the opening until the ostium is in its normal position.

CHAPTER XIV.

The Frontal Sinus.

THE function of the frontal sinus, outside of furnishing secretions to the nasal chambers, would seem, from its position on the prominent ridge of the frontal bone, not only to act as a buffer in case of violent blows, but also to protect the brain from cold by interposing a warm air chamber.

It is frequently infected and while theoretically there may be a primary infection of the frontal sinus, practically it is always an extension of an infection from the anterior ethmoidal cells.

If it were not for the complicated exit of its duct, it would be ideally drained, being the one paranasal cell with the ostium in the most dependent part.

The naso-frontal region is an outgrowth from the upper part of the middle meatus. In this region are ethmoidal cells, embryologically any one of which may become the frontal sinus. The upper end of the middle meatus is in the frontal recess mesially, under the anterior superior part of the middle turbinate. Lateral to the frontal recess, lies the upper part of the infundibulum ethmoidalis, from which have evaginated the infundibular ethmoidal cells. On account of the possibility of these

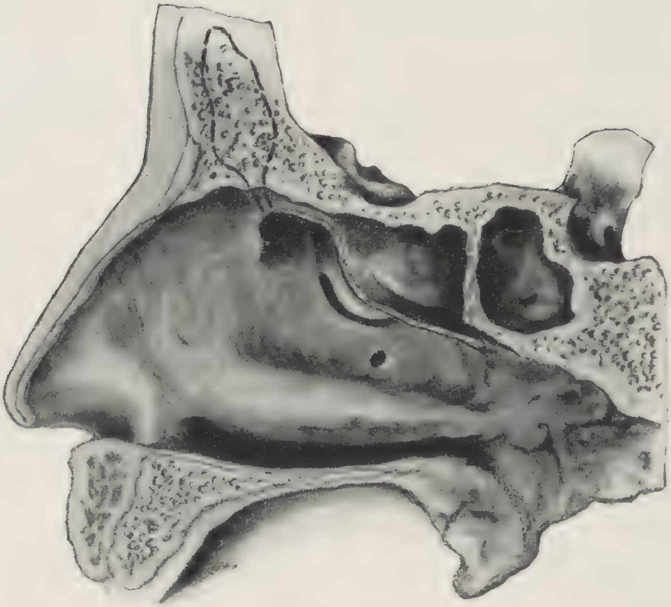

Fig. 133.—A frontal sinus opening directly into the frontal recess. This frontal sinus is formed from a frontal recess cell, and is the normal position for the frontal ostium. It is this class of sinuses that can be probed, and when infected, pus flows into the middle meatus without pressure symptoms. The accessory ostium of the maxillary antrum is seen, with the normal opening just above in the lower end of the infundibulum ethmoidalis.

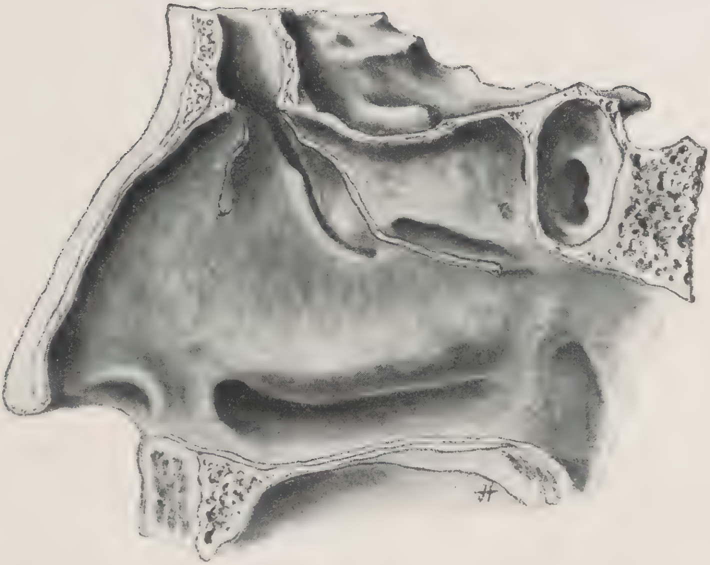

Fig. 134.—The lateral wall of the nose with the middle turbinate removed. The upper part of the attachment of the middle turbinate is cut away, giving a view of the frontal sinus opening directly into the infundibulum ethmoidalis. This outlet of the frontal sinus gives a direct communication into the antrum, the ostium of which is just at the lower end of the infundibulum ethmoidalis.

cells becoming the frontal sinus, they are known as the frontal cells.

The frontal sinus will develop in one of three ways:

First, there may be a direct extension of a cell from the frontal recess, which is found in practically forty-seven per cent. of the specimens. Under these circumstances, the opening from the frontal sinus is directly into the frontal recess or upper part of the middle meatus. While this opening may be irregular, made so by the projection of adjacent cells. it is the one formation that can be probed. This ostium would be closed by any swelling in the frontal recess, or on the lateral side of the middle turbinate.

In a case of a suppurative discharge of the frontal sinus, the secretion would flow directly into the middle meatus and then into the nasal fossa. The discharge would not drain into the maxillary sinus as it is not diverted toward the maxillary ostium. Rarely would this form of frontal sinus development cause vacuum headache, and if infected, there would be discharge without pain. This, we believe, is the normal development of the frontal sinus, even though it is only present in forty-seven per cent. of the specimens. The best way is always nature's normal way.

Second, the infundibulum ethmoidalis may have evaginated direct from its upper end, an ethmoidal

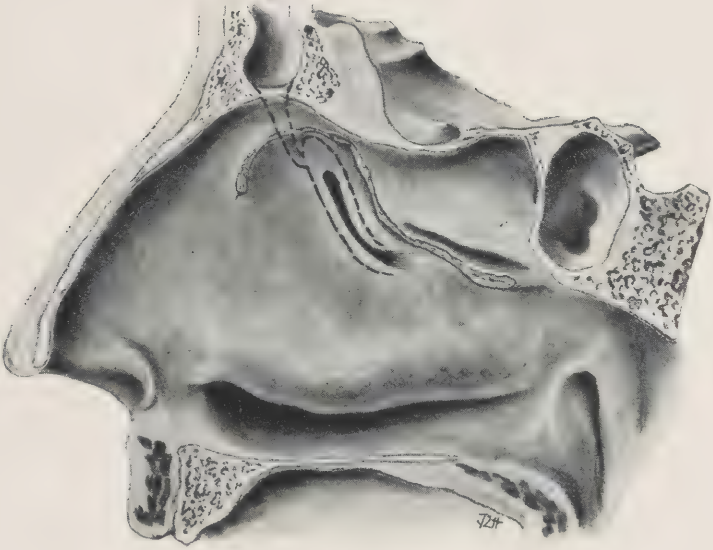

Fig. 135.—The middle turbinate removed showing its attachment. The dotted lines show how the frontal sinus can open indirectly into the infundibulum ethmoidalis, then have a direct passage to the maxillary antrum. It is practically impossible to probe this frontal sinus. These are the cases where the antrum acts as a reservoir in frontal sinusitis.

cell which will develop to form the frontal sinus. The infundibulum is a tubular gutter which lies directly on the bony lateral wall and extends from the region of the frontal sinus to the ostium maxillaris. If this development of the frontal sinus takes place, the discharge would flow down the infundibulum into the ostium maxillaris and the maxillary sinus would become a reservoir for an infected frontal sinus.

In order to reach the middle meatus, the discharge would have to leave the infundibulum by way of the slit-like opening called the hiatus semilunaris.

Third, the frontal sinus may develop from an ethmoidal cell that opens into the infundibulum in an indirect way, or with two pathways, one going into the infundibulum, and the other into the frontal recess.

The second and third forms of cell formation comprise about fifty-three per cent of the specimens examined. It plainly explains the frequent occurrence of the maxillary sinus as a reservoir for ethmo-frontal suppurations. This indirect placing of the frontal sinus ostium would tend to poor ventilation and consequently to infections. This class of cases is more subject to vacuum headaches. Slight enlargement of the fronto-nasal canal by infraction of the middle turbinate will often bring relief.

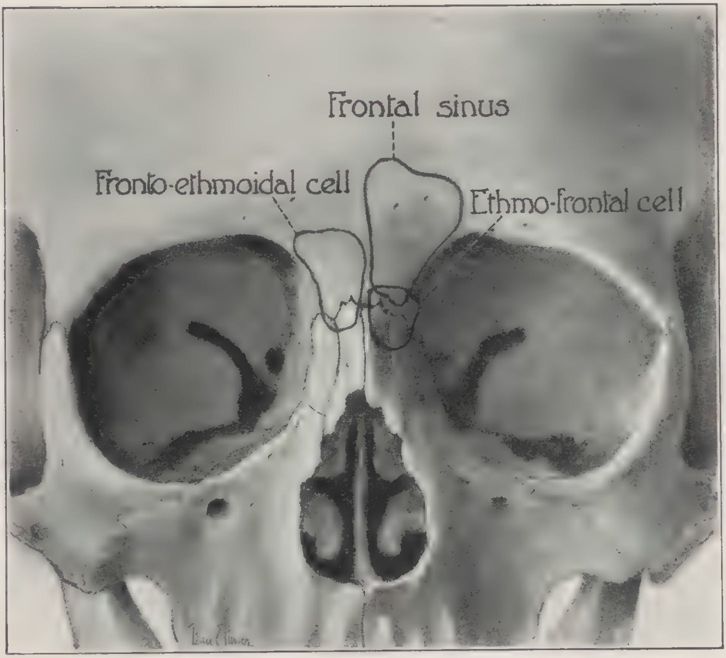

Fig. 136.—The fronto-nasal suture is a dividing line. Any cell below this line is an ethmoidal cell. When the greater part of the cell is below this line, it is an ethmo-frontal cell. When the greater part of the cell is above this line it is a fronto-ethmoidal cell. When the cell is above this line it is a frontal sinus cell.

There is no reason to think the frontal sinus is developed from one particular ethmoidal cell. Crowding up toward this space are a number of cells, any one of them may outgrow the others and become the frontal sinus, or two may coalesce and form the frontal sinus. The nasal floor of the frontal sinus is therefore made up of a number of anterior ethmoidal cells, the breaking down of which form a direct opening into the frontal sinus.

At birth, we have what may be designated as an ethmo-frontal cell, more ethmoidal than frontal, which is the rudiment or anlage of the future sinus. In a few months or years, it becomes a fronto-ethmoidal cell, more frontal than ethmoidal. So it develops until, in the adult, we have the normal frontal sinus. The development of the frontal sinus may stop at any point, as an ethmo-frontal cell, a fronto-ethmoidal cell, or a frontal cell or sinus. The line of demarcation should be the naso-frontal suture. When the greater portion of the cell is below this line, it is an ethmo-frontal cell. When the greater part of the cell is above this line, it is a fronto-ethmoidal cell. When all of the cell is above this line, it is a frontal cell or frontal sinus. It should be technically known as a frontal sinus only when above the naso-frontal suture.

Opening into the anterior ethmoidal cells will give free drainage to the ethmo-frontal and fronto-ethmoidal cells, while it may only open the lower

Fig. 137.—A specimen showing the true frontal sinus with the entire cell lying above the fronto-nasal suture.

end of the naso-frontal duct in the true frontal sinus.

In adults are found all shapes and sizes of frontal sinuses, symmetrical or asymmetrical. Having a well conceived idea of the location and shape of a normal frontal sinus, one can easily understand and discover the abnormal.

The normal frontal sinuses are cavities located in the superciliary ridge of the frontal bone. They are triangularly pryamidal in shape, with their bases separated by the septum frontalis, which is always present. The apex ends normally at the supra-orbital notch. The three other surfaces are the horizontal roof and the anterior and posterior surfaces formed by two plates of the frontal bone. The ostium is located near the junction of the anterior and horizontal surfaces, with the base the lowest portion of the sinus. One can now appreciate the abnormal specimens, that occupy other portions of the frontal plate. With the x-ray, or by probing, one can discover any misplaced ethmoidal cells which have become fronto-orbital cells and have no connection with the frontal sinus.

ACUTE FRONTAL SINUSITIS.

The diagnosis, as a rule, offers no difficulties. The pain in the supra-orbital region, tenderness of Ewing's point, localized congestion in the brow on bending forward, with possibly a secretion exuding

Fig. 138.—A specimen showing the frontal ethmoidal cell, when the greater portion lies above the fronto-nasal suture.

from under the anterior end of the middle turbinate makes the diagnosis clear.

On examination, the anatomical deformity, generally due to a deflected septum, gives the true etiology, while the infection shows the present cause.

In the acute stage, the mucous membrane of the nose is swollen and hyperemic, until it is impossible to distinguish any but the gross nasal landmarks. A spray of four per cent. cocain solution will contract the tissues so an examination is possible. If there is sufficient space, infraction of the middle turbinate is indicated. As soon as the first immunity is established, the frontal sinus can be opened intranasally. Generally there is immunity enough by the third day.

The pain of supra-orbital neuralgia is differentiated by tenderness at the supra-orbital notch.

The referred pain of nasal ganglion neurosis can be blocked by anesthetizing the nasal ganglion.

The pain of vacuum headache can be relieved at once by intranasal opening of the sinus.

CHRONIC FRONTAL SINUSITIS.

There is dull pain over and between the eyes, or there may be no pain at all. As the anterior ethmoidal cells are usually affected there are increased secretions, either serous or purulent.

Fig. 139.—A specimen showing the ethmo-frontal cell where the greater part of the cell lies below the fronto-nasal suture.

INTRANASAL FRONTAL SINUS OPERATION.

An x-ray should first be taken to establish the presence of a frontal sinus. It is extremely simple after the anterior ethmoids have been exenterated by the "under the middle turbinate" method, to enlarge the frontal sinus opening, with rasps (as recommended by Dr. Good years ago), using the Thompson rasps.

The space necessary for an intranasal opening into the frontal sinus is five to seven millimeters. This is a little less than the width of the articulation of the ethmoid bone with the frontal. A workable outline shown on the patient is the space between the internal canthus and the central perpendicular line of the nose.

The instruments used are a nasal speculum, Gruenwald biting forceps No. 3, Pratt's double end ethmoid curette, frontal applicators, Good-Thompson rasp set.

For anesthesia, the anterior ethmoidal nerve and spheno-palatine ganglion are blocked. After the anterior ethmoids are exenterated further anesthesia will be necessary in the frontal sinus duct region. This is obtained by cocain swabs on the ends of curved applicators.

The patient is seated with the head tipped well back on the head rest. With the nostril dilated with the nasal speculum, the point of the straight end of the Pratt curette is placed just under the attachment

Fig. 140.—A specimen showing a true frontal sinus situated above the fronto-nasal suture. The frontal septum between the two sinuses is shown. This septum always begins below in the center.

of the middle turbinate, on a line with the nasal bridge and pointing toward the inner canthus of the operating side. With firm pressure, break into the anterior ethmoidal cells. This cavity is then enlarged by curetting upward, backward and downward, for not less than one-fourth of an inch in each direction, or the entire space occupied by the anterior ethmoidal cells may be exenterated.

The angled end of the curette is now inserted with the cup pointing forward, and curetting motions are made in an arc form toward the tip of the nose. The smooth, firm bone will be recognized as soon as all these anterior ethmoidal or agger nasi cells have been broken down and removed. As the nasal floor of the frontal sinus is formed by the anterior ethmoidal cells, which have just been removed, if the opening is large enough, the end of the curette will slip into the frontal sinus. Bleeding can be stopped, if necessary, by swabs dipped in iodin-glycerin solution, or epinephrin chlorid.

With beginners it is well to attempt passage of the frontal probe of the rasp set, and if successful, the little groove on the rasp placed on the probe gives the correct direction for the point of the rasp. After a few trials, the rasp is used directly without the use of the probe. To find the frontal opening, take the sharper curved rasp, and pass in under the attachment of the middle turbinate, into the exenterated space of the anterior ethmoidal cells. Point the

Fig. 141.—A specimen showing a large fronto-ethmoidal sinus, the ostium of which opens directly into the infundibulum.

tip of the instrument toward the frontal sinus in an imaginary space marked by a central perpendicular line with a parallel line passing through the internal canthus. By working delicately upward with a rasp motion in this direction, you will either find the normal opening or break through intervening cells into the frontal sinus. The rasp cuts on the pull, so enlarge your opening accordingly. The back of the Good-Thompson rasp is smooth, so the cut is always forward and away from any danger. The cutting forward does not destroy the membrane covering the posterior half of the duct or opening. Later, by probing and removing any granulations, the opening will soon be completely lined with mucous membrane. Any operator who removes all the mucous membrane will have great difficulty to maintain a patulous opening. The improvement of the rasps by Dr. Thompson, greatly increased the cures and is the link that placed the intranasal operation in the position it occupies today. The opening should be large enough to pass, with ease, a three millimeter canula. This diameter is maintained by using frontal dilators until the case is cured. If granulations form or the hole contracts, the rasp is again used.

If symptoms of brain involvement, or necrosis are present, the above operation is not sufficient. It must be combined with the external radical operation.

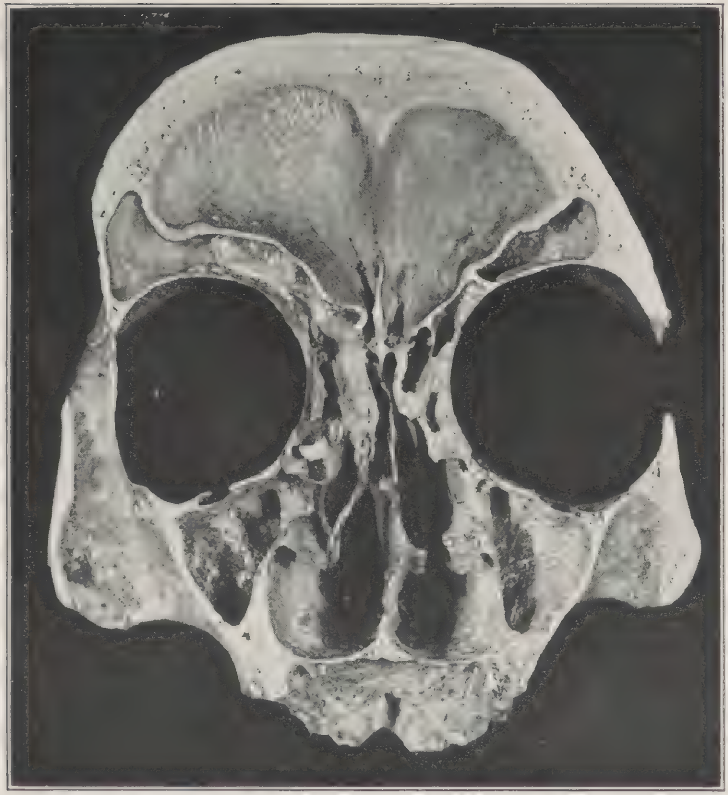

Fig. 142.—The front half of a specimen showing extremely large fronto-orbital cells. It shows very clearly that exenteration of the anterior ethmoidal cells would drain these cavities. The frontal sinus would be anterior to the crista galli, which is shown.

Fig. 143.—The posterior portion of the section showing the extremely large fronto-orbital cells. These cells are in direct communication with the anterior ethmoidal cells.

Fig. 144.—A specimen showing the frontal sinus opening direct into the infundibulum ethmoidalis. A wire is passed from the posterior portion of the lower part of the frontal sinus down through the infundibulum ethmoidalis into the antrum maxillaris. Any secretion from the frontal sinus would flow directly into the antrum showing clearly how the antrum acts as a reservoir. The section is made just posterior to the frontal sinuses, cutting through the crista galli, which is shown. A small posterior portion of the frontal sinus on both sides are opened with wires protruding. The wire on the left side does not pass into the antrum, but the infundibulum ethmoidalis is easily traced from the frontal sinus to the antrum, as it lies along the orbital wall.

Fig. 145.—A specimen showing the frontal sinus opening into the frontal recess giving direct communication from the frontal sinus to the middle meatus. It is this form of frontal duct that is easily probed.

Fig. 146.—A specimen where the frontal sinus is opening into both the infundibulum and the middle meatus, being divided by the edge of the uncinate process.

Fig. 147.—Instruments used in opening the frontal sinus intranasally. 1. Pynchon nasal speculum; 2. Pratt ethmoidal curette; 3. Gruenwald No. 3 biting forceps; 4. Ritter dilators; 5. Good-Thompson rasp set: *a*, sharp curved rasp; *b*, flat curved rasp; *c*, probe; 6. Washing canula; 7. 3-ounce metal syringe.

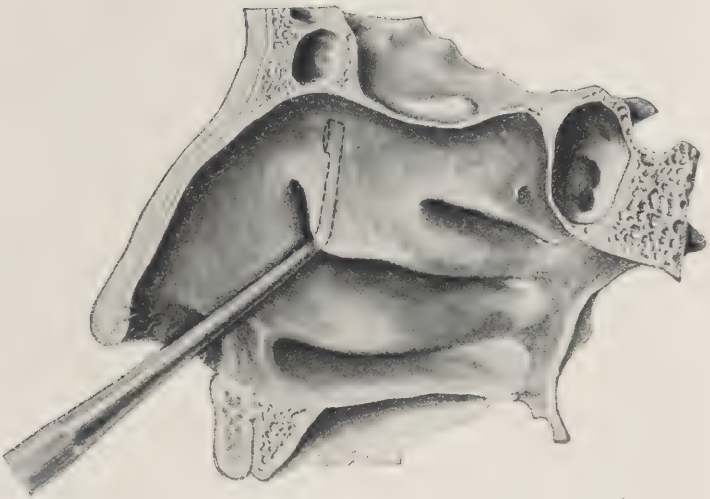

Fig. 148.—The curette breaking down the cells leading to the frontal sinus.

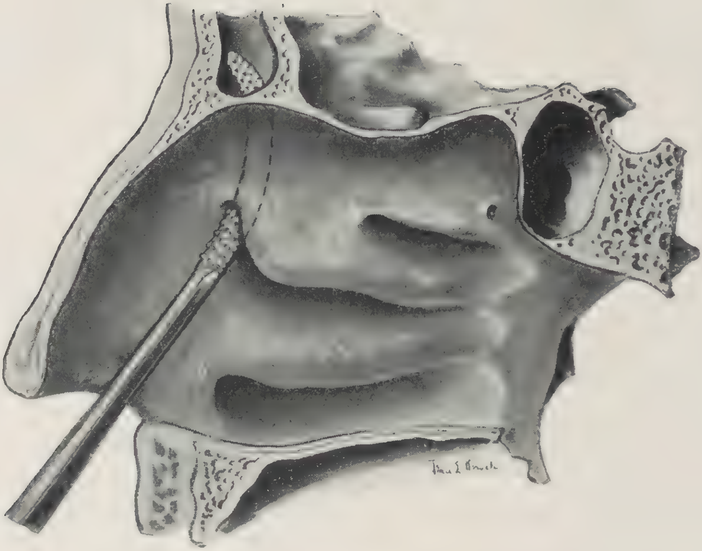

Fig. 149.—The position of the Thompson-flat-backed rasp in the frontal sinus under the middle turbinate, after the anterior ethmoids have been exenterated. It is frequently only necessary to exenterate this anterior group of the anterior ethmoidal cells to open directly into the frontal sinus. With the anterior attachment of the middle turbinate in position, the rasp is very easily introduced.

Fig. 150.—The Good-Thompson rasp in the left frontal sinus. Tipping the rasp toward the left, the point of the rasp is about at the inner edge of the eyebrow. Drawing imaginary lines perpendicularly through the center of the nose and the inner canthus of the left eye, the rasp lies about midway between these lines.

Fig. 151.—The Good-Thompson rasp is under the anterior end of the middle turbinate into the frontal sinus.

Fig. 152.—A No. 6 Ritter frontal dilator in the frontal sinus. A No. 6 is four millimeters in diameter, and if a frontal sinus ostium is enlarged to this size, it will meet nearly all intranasal requirements. When the dilator is in the frontal sinus, the lower part of the dilator lies on the upper lip.

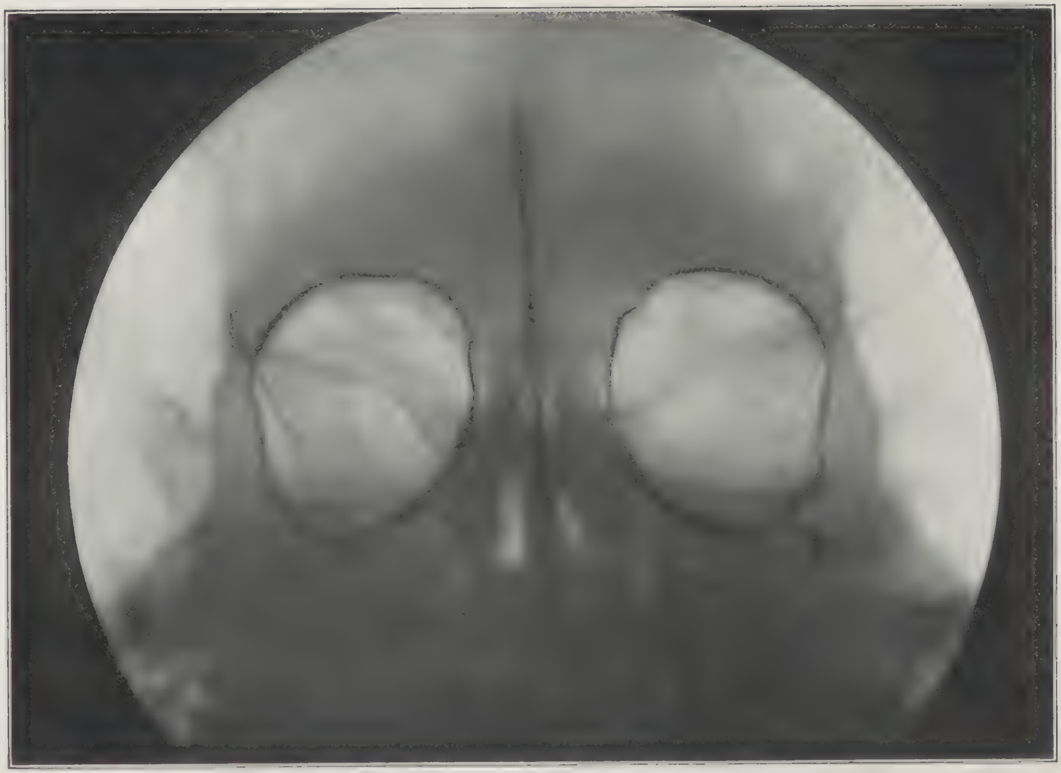

Fig. 153.—An X-ray plate showing absence of the frontal sinuses.

Fig. 154.—An X-ray plate showing well marked frontal sinuses, with broad floors opening into the anterior ethmoids. The left is the larger of the two sinuses, and while the partition starts in the center, it quickly deviates to the right, leaving the crista galli in clear view. The positions of the antra under the orbits are clearly shown. The wide ethmoidal capsule leading from the frontal sinuses to the antra show how the breaking down of the partition of these cells would give direct communication between these cavities and make the antra the reservoirs for the frontal sinuses.

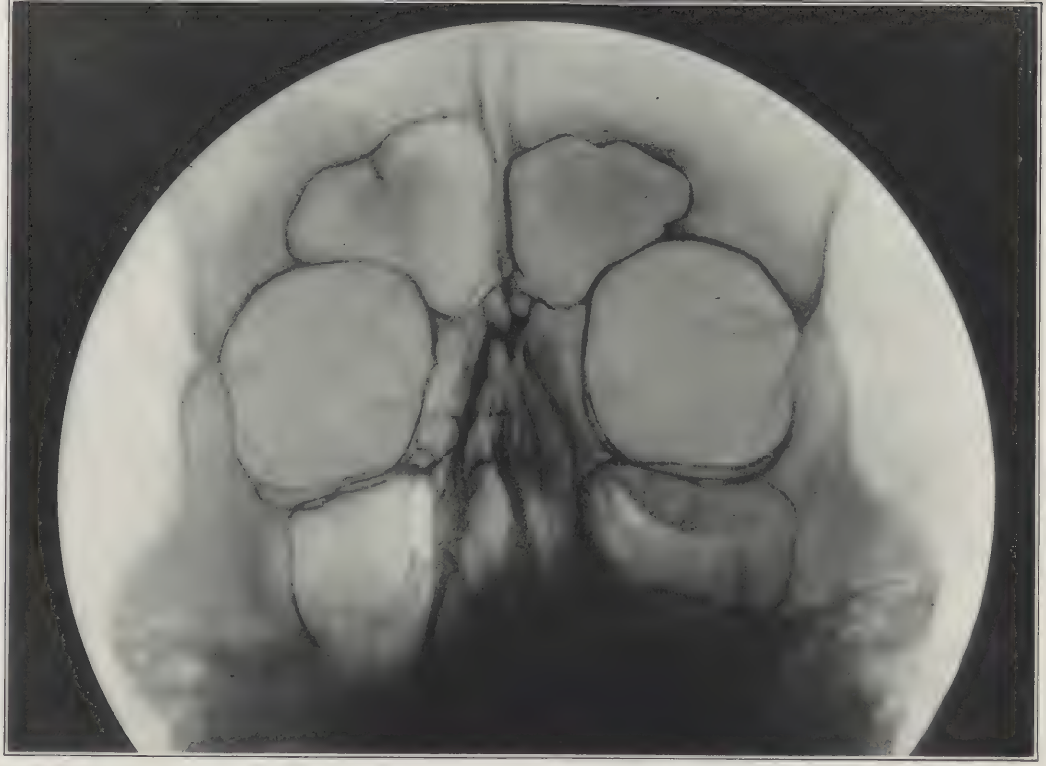

Fig. 155.—This X-ray plate shows large frontal sinuses, with broad floors leading to the anterior ethmoids. The ethmoidal capsules are well outlined and show their connection with the antra. The right antrum is narrow and high, while the left is broad and shallow. The thin plates of bone between the frontal sinuses, the ethmoidal capsules, and the antra and orbits are very clearly shown.

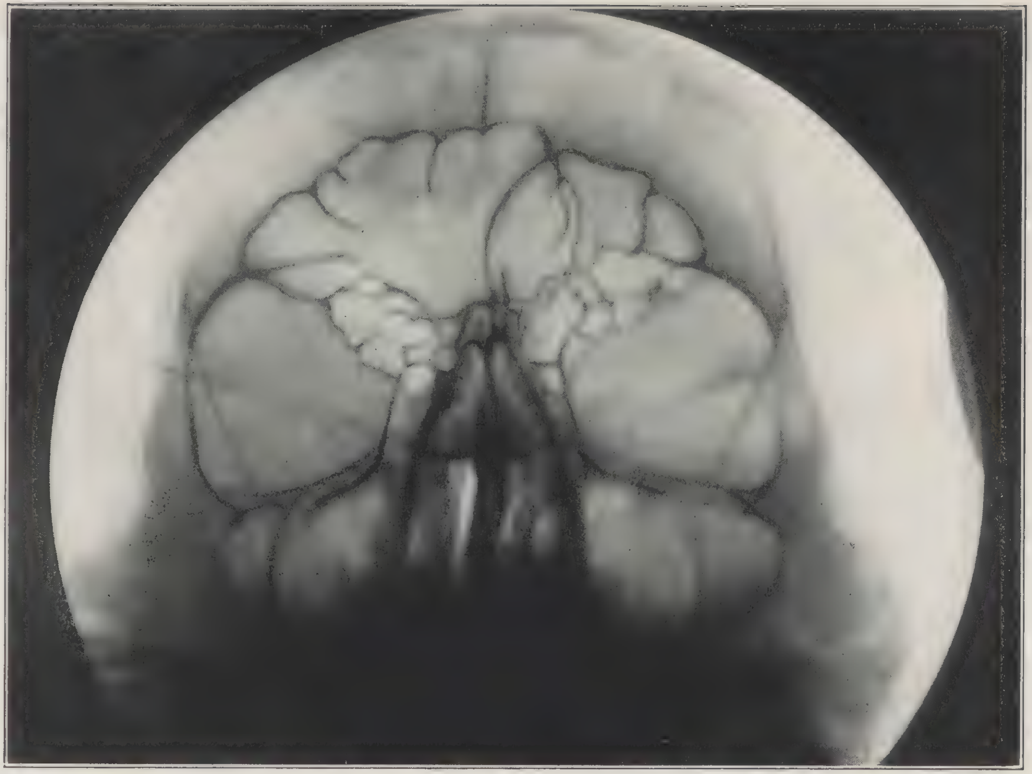

Fig. 156.—This X-ray plate clearly shows the very large frontal sinuses, with partial partitions and ridges running from the periphery. The partition between the sinuses starts from the center but deviates to the left. There are a great many small orbito-frontal cells extending from the ethmoidal capsules.

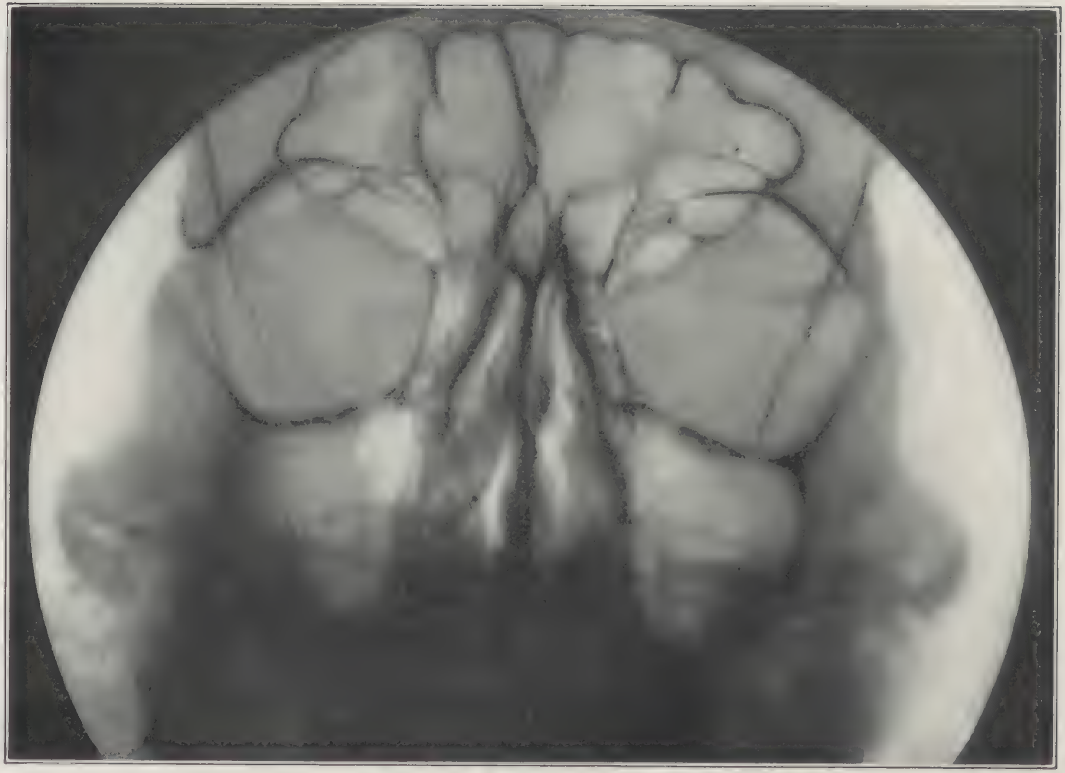

Fig. 157.—This X-ray plate is of a very pneumatic head. The frontal sinuses are extremely large. The right frontal sinus looks double, the appearance is due to a heavy ridge. There are large orbito-frontal cells and the crista galli has a large cell. The antra are well developed.

Fig. 158.—A front view X-ray plate showing the large orbito-frontal cells and the frontal sinuses. The head is tilted slightly forward.

Fig. 159.—A side view X-ray plate of the case of Mr. S., showing the rare orbito-frontal cells and also large frontal sinuses.

Fig. 160.—This X-ray plate is a side view of the case of Mr. S., showing the applicators in the right orbito-frontal cell and in the right frontal sinus.

Fig. 161.—This X-ray plate is a direct front view of the case of Mr. S., and shows an applicator in the orbito-frontal cell and one in the frontal sinus on the right side.

Fig. 162.—A side view of the case of Mr. McK., showing a rasp in the frontal sinuses.

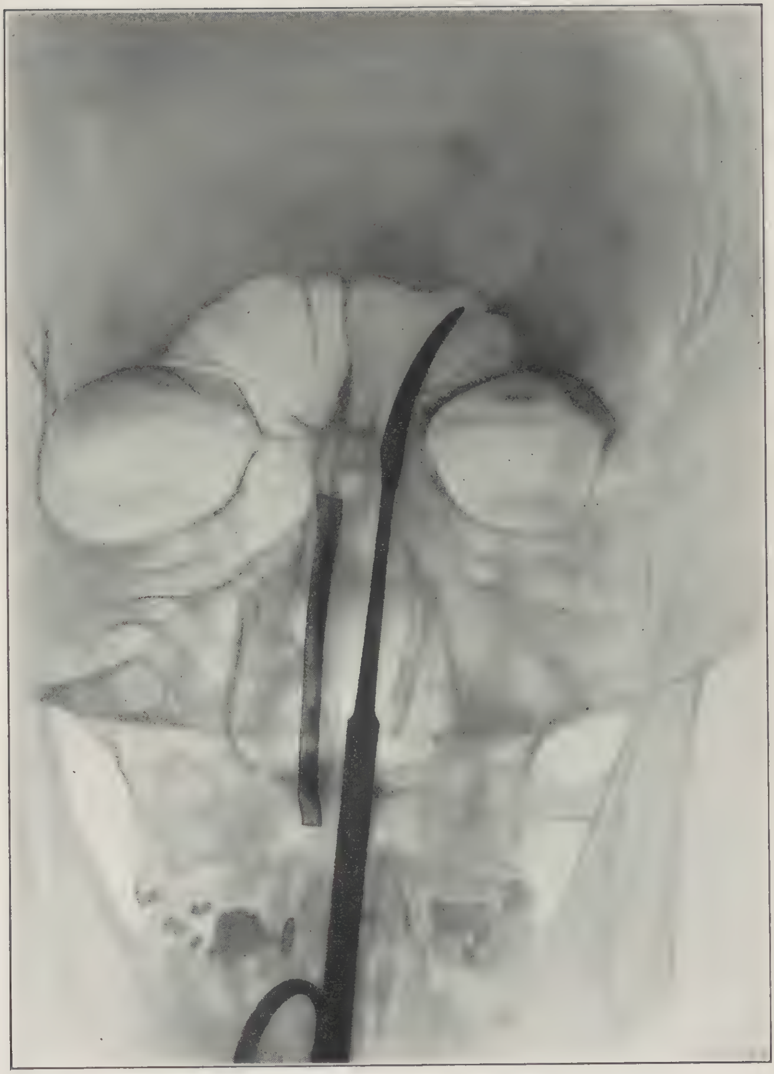

Fig. 163.—A front view of the case of Mr. McK. The rasp is shown in the frontal sinuses. A strip of lead is placed along the bridge of the nose to designate its position on the plate.

Fig. 164.—X-ray plate of the case of Mrs. F., showing the Ritter frontal dilators, Nos. 5 and 6, in the frontal sinuses.

Fig. 165.—A side view X-ray plate of the case of Mrs. F., with the Ritter frontal dilators Nos. 5 and 6 in the frontal sinuses.

Fig. 166.—A side view X-ray plate of the case of Mrs. F., with a Ritter frontal dilator No. 6. The nasal spine which is rasped to enlarge the frontal ostium is clearly shown.

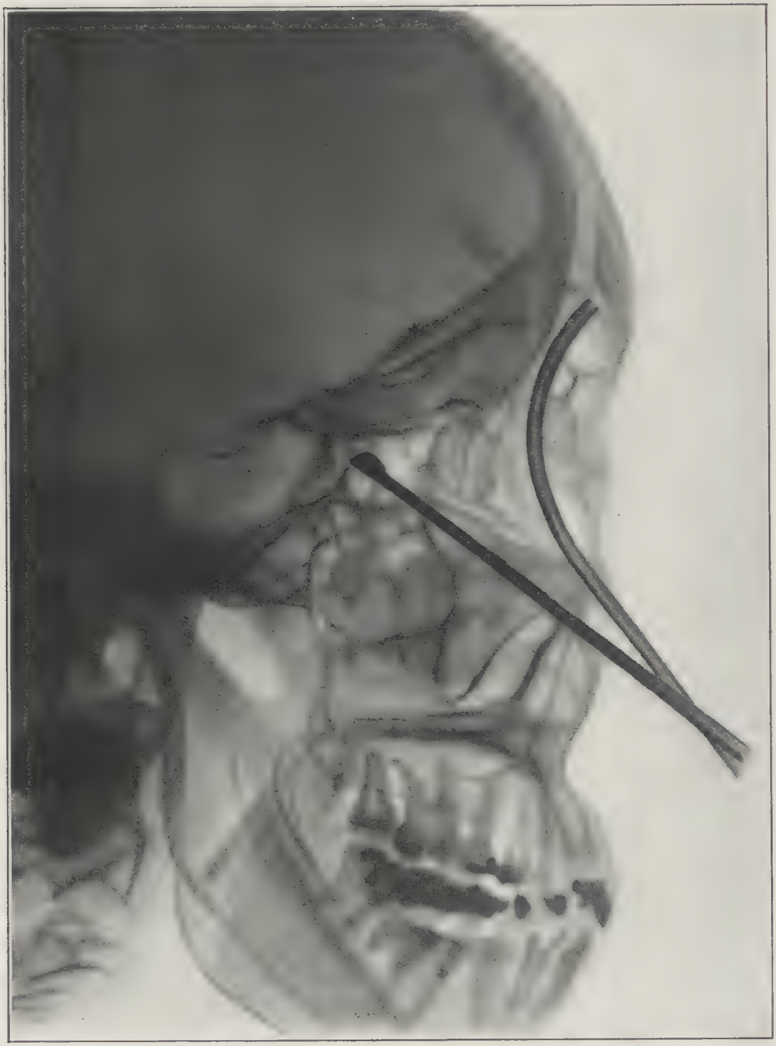

Fig. 167.—X-ray plate of the case of Mrs. D., shows the suction catheter in the frontal sinus and a curette in the posterior ethmoidal space.

Fig. 168.—Mr. H. had a radical operation of the frontal sinuses, with complete removal of the frontal plate. In the X-ray plate, the curette is up to the floor of the frontal sinus. A sheet of lead is shown the length of the crest of the nose and also lying on the floor of the frontal sinuses in the depression.

Fig. 169.—The X-ray plate of the case of Mr. H. is a side view, showing the curette up to the floor of the sinuses and the great deformity caused by the radical operation.

CHAPTER XV.

The Maxillary Sinus (Antrum of Highmore).

The maxillary sinus was first described by Dr. Nathaniel Highmore in 1651, although its presence was known hundreds of years before. The sinus is evaginated from the lower end of the lateral wall of the infundibulum ethmoidalis. It is first noticeable about the seventieth day of fetal life, when it is a slit-like cavity in the membranous lateral wall of the nose. By the process of development and resorption as the slit grows in capacity, it sinks into the body of the maxillary bone.

Sometimes there is a double ostium, which can be explained by a double evagination. This also might account for the partial partition found in the sinus, the walls of the cavities absorbing when they come in contact with each other. If there is a double maxillary sinus and the ostium of one cavity opens directly into the middle meatus, that cavity is a misplaced anterior ethmoidal cell.

The average length of the sinus anterio-posteriorly is, at one hundred days, two millimeters, at seven months, five millimeters, and at term, seven millimeters. The size practically doubles during the first year of life.

In the adult, the measurements will average in length, thirty-four millimeters, in height thirty-three millimeters and in width, twenty-three millimeters.

The adult maxillary sinus is, as a rule, the largest paranasal sinus. It lies in the body of the maxillary bone, lateral to the nasal cavity. It is pyramidal in form with the base toward the nasal cavity and its apex toward the zygomatic process. It has a roof under the orbit, a base toward the nasal fossa, a floor toward the alveolar processes, an anterior wall and a posterior wall. The thinnest wall is the base which occupies nearly two-thirds of the lateral wall of the nose.

HIATUS MAXILLARIS.

This lateral wall or base of the sinus has a very irregular orifice in the disarticulated maxillary bone, which is known as the hiatus maxillaris. This opening is partly filled by the pars perpendicularis of the palate bone posteriorly, the inferior turbinate inferiorly, the lachrymal bone anteriorly, and the uncinate process centrally. The remainder of the opening is filled in by membrane.

It is the dehiscence in this membranous wall that forms the accessory ostium of the maxillary sinus and is a direct passage between the antrum and nasal fossa. The primary ostium opens into the infundibulum ethmoidalis, then through the hiatus semilunaris into the nasal fossa.

Fig. 170.—A section showing the size and shape of the antra.

SINUS FLOOR.

The relation of the sinus floor to the nasal fossa depends upon the hollowing out of the alveolar process. The floor is generally below the level of the nasal fossa. The roots of the teeth frequently project into the floor of the antrum and are covered by very thin bone. If these roots become diseased they could easily infect the antrum.

MAXILLARY SINUSITIS.

While the majority of the books claim the antrum the most often diseased of the paranasal sinuses, we have not found this true. We find the anterior ethmoidal cells are the most often diseased and the frontal sinuses next. In our experience, in about fifty per cent. of antrum cases, the antra act as a reservoir to discharge from the anterior ethmoidal cells and frontal sinuses. The remaining forty per cent. we find due to the following causes:

A. From the alveoli; diseased teeth affecting the soft tissues and bone of the antrum floor are the most common.

B. Infectious diseases; influenza, scarlet fever, etc., in which the diseases of the antrum generally clear up with the cure of the infectious disease.

C. Extension from the nasal mucosa (coryza) which is of short duration.

D. Conditions arising within the sinus itself (idiopathic), which are rare.

Fig. 171.—An X-ray showing one antrum involved.

E. Foreign bodies; Through the natural and the accessory ostia may enter vomited matter, parasites or other foreign bodies. Foreign bodies may pass through the bony nasal or maxillary wall, injuring the tissues and lodging in the antrum. Broken tooth roots may be forced, during extraction, into the antrum, and foreign bodies may pass in by way of the artificial opening after the extraction of a tooth.

F. Direct traumatism; An empyema can be caused by injury to the antrum walls, such as falls, blows, unskilled extraction of teeth, infections following diagnostic puncture of the antrum, etc. Indirectly, by intranasal surgical operations as tamponing the nose and the use of the galvanocautery.

CYSTS.

Mucoid cysts of the antrum can be diagnosed by the x-ray and by puncture.

Dentigerous cysts are caused by disturbances in dentition and are due to two causes, an unerupted tooth and the inflammatory changes of an infected tooth. They may become even larger than the antrum as in the specimen shown. They are discovered by the swollen, distorted walls of the mouth, nose or maxillary sinus. In cholesteatoma the antrum is filled with a thick cheesy mass.

ACUTE INFLAMMATIONS.

In acute inflammation of the antrum, there is a feeling of distention and pressure due to the swelling

Fig. 172.—An X-ray showing both antra involved. Compare with shadows in the eye sockets.

and hyperemia of the mucous membrane. It is rare to have any localized inflammation of the sinus earlier than the first year of life. Only palliative measures, the usual coryza treatment and heat should be used. There is seldom severe pain at this stage and only a feeling of discomfort in the region of the antrum.

An inflammation of the antrum may irritate the nasal ganglion and we may have all the nasal ganglion syndrome with possibly little reference to the antrum.

Generally, stooping, coughing or sneezing will direct the attention to the antrum. Pain localized directly in the antrum is usually due to ulcerations of the soft parts or to inflammation of the underlying bone.

Secretions are seldom present before the third day of the infection and then the character depends upon the causative factor. Nasal infections run from serous to purulent, while the secretions of dental origin are usually thick, fetid, and at times, caseous.

The secretion usually appears in the middle fossa, and has a very disagreeable odor. The patient may come for examination in the morning when the antrum has emptied itself into the pharynx, so our examination will not reveal any discharge. Frequently the patient may be wrongly doubted when he complains of the great amount of the secretion.

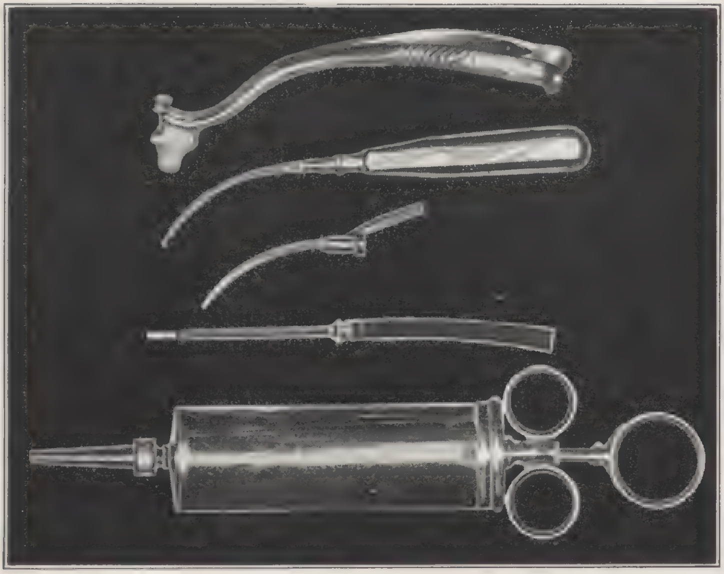

Fig. 173.—Instruments used in puncturing the maxillary antrum. 1. Pynchon nasal speculum; 2. Coakley antrum punch; *a*, trocar; *b*, canula to fit over the trocar; *c*, canula attachment for syringe; 3. three-ounce metal syringe.

There may or may not be the general symptoms of acute infection, with loss of smell, dryness of throat and nervous manifestations. There are seldom complications unless the infection is of an extremely virulent type or the patient is in a greatly run-down condition.

CHRONIC INFLAMMATION.

In chronic empyema of the antrum, the complaint is mostly in reference to the discharge. There may be mild pain or continual fullness. There may be neuralgic pain from infra-orbital nerve irritation or nasal ganglion congestion, and is generally worse when the sinus is full of secretion.

In degeneration of the sinus walls, as caries of the bone and ulcerations, the pain may be very severe. The secretion may be serous, mucoid, mucopurulent and with odor from dental necrosis, or putrefaction of retained discharge.

As a large number of infected antra are caused by diseased teeth, the mouth should be first inspected. Molar teeth that have been filled or are carious, should be x-rayed to determine if any of the roots are abscessed.

The nose must be examined to determine if there is an anterior ethmoidal or frontal sinus disease present.

Fig. 174.—Shows the position of the Coakley antrum trocar as it enters the antrum.

SUCTION OR NEGATIVE PRESSURE.

After the nose is thoroughly cleared of secretions, a suction pump is applied to the anterior nares and the nasal cavities frequently examined to see if any secretion appears in the middle meatus. Discharge under the middle turbinate may come from the anterior ethmoidal cells, the frontal sinus or the antrum.

TRANSILLUMINATION.

The patient is placed in a dark room, or the patient's and operator's heads are covered with a hood. Dental plates should be removed from the patient's mouth. The illuminating lamp is now placed in the patient's mouth as far back as possible against the hard palate and the lips closed, the light is gradually brightened by the rheostat turned to full capacity of the lamp. If there is no secretion or abnormality in the antrum, the canine fossa or infra-orbital region will be bright and the pupil dimly lighted. The patient will also see the light. If one side is more dim than the other or not illuminated, it is evident there is obstruction of light, either by thick bony walls, opaque secretion or tumors. As there are some secretions that are translucent, this test is not infallible. The diseased mucosa may arrest light rays as it does x-rays and give the appearance of secretion in the antra. This test is a valuable adjunct to diagnosis.

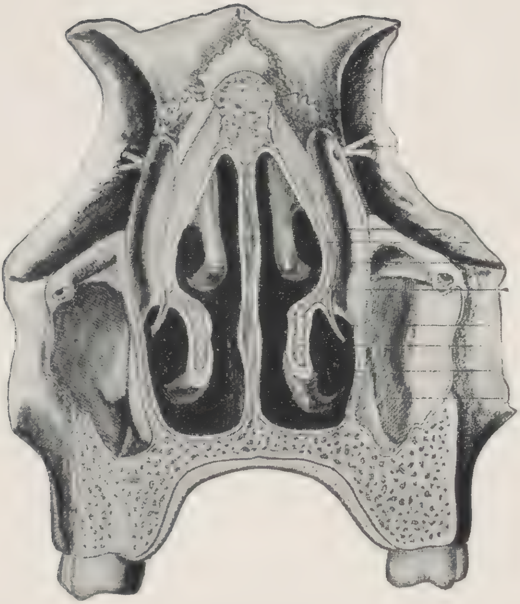

Fig. 175.—A diagrammatic drawing to show the position of naso-lachrymal ostium of the naso-lachrymal duct, high up in the lower meatus on the lateral wall, just posterior to the anterior attachment of the inferior turbinate. As the antrum puncture is made at least one-half of an inch posterior to the anterior attachment of the inferior turbinate the opening is avoided.

As about fifty per cent. of adults have accessory ostia of the antrum, the antrum will frequently suddenly empty itself when the head is held in a certain position. When the head is bent forward, it will often run out in a thin stream and with the head backward, will suddenly empty into the pharynx. With the head leaning to the opposite of the diseased side and blowing the nose, the patient can frequently empty the antrum by siphonage. This is a trick many patients have discovered and the larger the ostium, the easier it is performed.

An x-ray of both antra including the eye sockets, should be taken to show, by comparison of the shadows, whether disease is present. The x-ray also shows the size, shape and position of the antra in relation to other structures of the nose.

When there is a closed empyema of the antrum there is bulging in the middle meatus of the lateral wall and the nose is usually blocked on that side. Antral puncture will generally diagnose between a closed empyema, cyst or tumor.

If a chronic infection is suspected the one positive method to determine if there is secretion present in the antrum is to puncture and wash out the cavity with normal salt solution.

If granulations or cholesteatoma are suspected, the antrum can easily and safely be explored through a six millimeter opening in the lateral wall made as near the anterior attachment of the inferior turbin-

Fig. 176.—A specimen showing a dentigerous cyst larger than the antrum of Highmore. The classic puncture of the antrum, under the lower turbinate opening into the antrum, would have opened into this cyst.

ate as possible, avoiding the naso-lachrymal ostium. With a small curette, bent twenty millimeters from the end at an angle of forty-five degrees, through this opening practically every portion of the antrum can be explored by touch, and any diseased condition determined. The angle end of the Pratt ethmoidal curette is very suitable for this purpose.

TREATMENT.

If an x-ray shows an abscess on the ends of the roots of any teeth in the floor of the antrum, the teeth should be extracted and the cavity curetted. If necrosis extends into the antrum the antrum edges around the tooth cavity should be curetted and the opening allowed to close.

In the after-treatment the secretion is washed out of the cavity by the way of the nose.

If the antrum is acting as a reservoir for the anterior ethmoidal or frontal sinus, these sinuses must be exenterated and the antrum kept clean until the condition above is cured. It should always be remembered that an infected antrum from an abscessed tooth may at the same time be acting as a reservoir for diseased ethmoidal cells or a frontal sinus.

Antral Puncture and Lavage.—The simplest and easiest method of treating antral diseases, with possibly the highest percentage of cures, is puncture and lavage.

Fig. 177.—Instruments used in opening the antrum intranasally. 1. Pynchon nasal speculum; 2. Ingal curved turbinal scissors; 3. Hartmann's heavy dressing forceps. 4. Good-Thompson rasps; *a*, sharp curved; *b*, flat curved; 5. West curved chisel; 6. Pratt ethmoid curette; 7. Gruenwald No. 3 biting forceps; *a*, Wagner's forward biting blade; *b*, Wagner's backward biting blade; *c*, Yankauer's right biting blade; *d*, Yankauer's left biting blade; 8, Washing canula; 9, three-ounce metal syringe.

A Coakley antrum trocar and canula is the best instrument for this purpose. It is curved so as to enter the antrum without having to push over the tip of the nose. The point of the instrument is made small to enter the antrum easily and the canula is cone-shaped so the trocar will not bind on removal. The lateral wall is anesthetized by blocking the nasal ganglion and anterior ethmoidal nerve and placing a small pledget of cotton dipped in ten per cent. cocain in epinephrin chlorid (1:1000), under the inferior turbinate, about one-half inch back of the anterior attachment.

The point of the trocar is placed under the inferior turbinate one-half inch back of its anterior attachment, and as high up on the lateral wall as the inferior turbinate attachment will permit. The point is now directed toward the external canthus of the eye of that side. Then with pressure that you have an instant check on, the point is thrust into the antrum. This point of admission is at the thinnest part of the bony lateral wall.

It is generally easy to tell when the trocar enters the cavity of the sinus, but unless this is known fluid should be injected with caution. After the sinus is well washed, the remaining water is blown out with air. Water macerates mucous membrane so the cavity must be kept as dry as possible. After the discharge has become thin, it can be sucked out with the suction pump instead of being washed out.

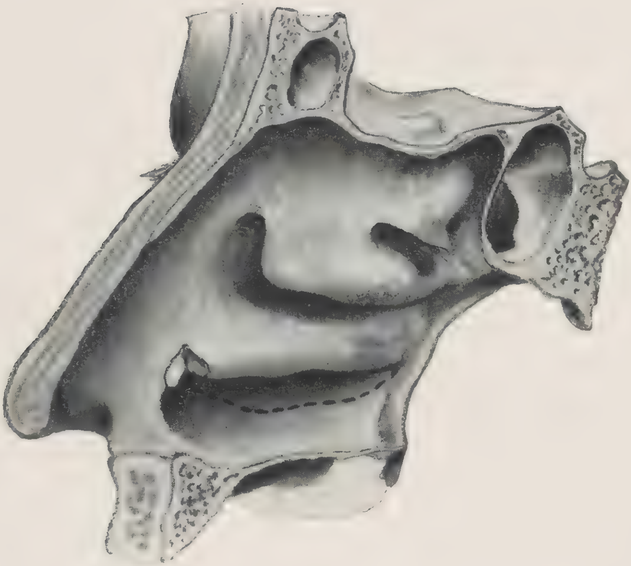

Fig. 178.—Three-quarter view of the lateral wall, showing the anterior attachment of the inferior turbinate cut and the turbinate broken up. This gives a good view of the lateral wall for operating on the antrum.

Complications of Antral Puncture.—Do not inject air before the water is used. Probably many deleterious results reported from antral puncture are due to first inflating with air.

If the point of the trocar is not sharp, the mucous membrane may be pushed away from the wall in front of the trocar. If air is now injected, an air embolism may be formed, while if water is used, there are no serious results. If the trocar is entered too near the anterior attachment of the inferior turbinate, the point may pass on into the cheek. If a check is not placed on the force used and the position of the trocar is too perpendicular, the orbit may be entered. If water will not flow freely on pressure of the syringe, the canula should be pulled back a little, as the end may impinge on the outer wall or against a polypus or growth. If there is still no flow with fair pressure, it will be necessary to enlarge the normal opening. This is done with an angular knife placed half-way back under the middle turbinate, pointed toward the molar teeth and pushed into the antrum wall, then drawn forward one-half inch.

Antrum Operation (Intranasal).—If an antrum is not cured in a month or more by washing through the antrum trocar, an operation to secure more permanent drainage is indicated.

A semi-radical antrum operation is performed by making a large opening under the inferior turbinate,

Fig. 179.—West chisel as it punctures the antrum. The chisel is now turned, making a round hole.

through the naso-antral wall. This opening can be made large enough for touch inspection of the entire antrum by the angular curette and for ocular inspection through the naso-pharyngoscope.

In operating on children, extreme care must be taken to avoid injury to the un-erupted teeth.

The instruments necessary for this operation are a Pynchon nasal speculum, Hartmann heavy dressing forceps, a curved chisel (West intranasal lachrymal sac chisel), heavy turbinal scissors, Good-Thompson frontal sinus rasp, a Pratt ethmoidal curette, a Gruenwald cutting forceps No. 3, a Wagner antrum punch for anterior and posterior biting, and a right and left Yankauer antrum punch.

The parts are anesthetized by blocking the anterior ethmoidal nerve, and the spheno-palatine ganglion as in the submucous operation and placing a swab of cocain and epinephrin chlorid under the inferior turbinate. Wait at least twenty minutes. The anterior attachment of the inferior turbinate is cut backward far enough with the turbinal scissors to allow the turbinate to be displaced upward with the Hartmann heavy dressing forceps, giving a good view of the lateral wall underneath. The turbinate can be packed in this position. With the West small curved chisel, an opening is made into the antrum about one-half of an inch posterior to the anterior attachment of the inferior turbinate, and the chisel turned to make a round opening. The

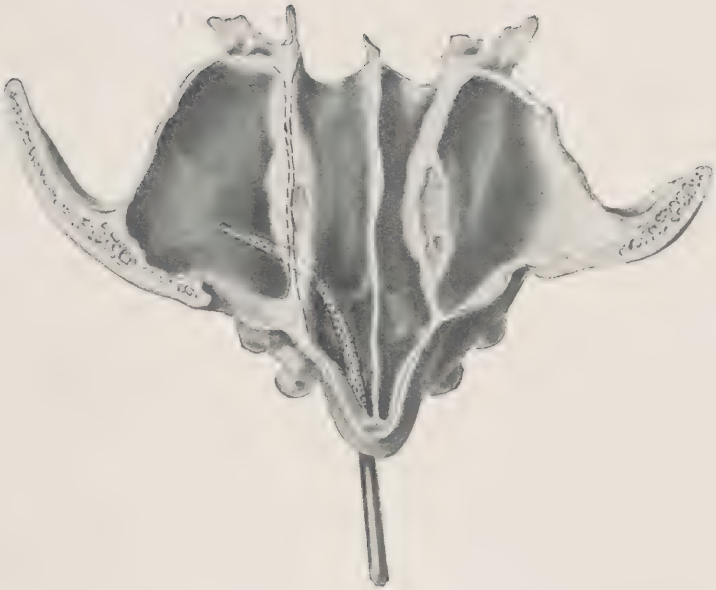

Fig. 180.—Thompson rasp in position, to rasp away the anterior wall of the antrum to enlarge the opening.

Good-Thompson frontal rasp is now used and the lateral wall anterior to the chisel hole is rasped away, until a hole is formed large enough to introduce a cutting forceps. The Wagner forward cutting antrum punch can now be used to enlarge the opening as far forward as possible. The Gruenwald cutting forceps or the Wagner backward cutting forceps are now adjusted to give a horizontal backward cut. If the Gruenwald cutting forceps are used, they are introduced closed into the nostril under the middle turbinate and when opened, the moving blade slips into the opening made by the rasp, and the lateral wall is then removed as far back as necessary. The Yankauer antrum punch is now used to remove the lower and upper edges of the opening. The antrum should be thoroughly inspected by touch with the end of the curette and the membranous lining curetted if necessary. The Pratt ethmoidal curette is ideal for this purpose with its angle of forty-five degrees and the bent portion length of two centimeters, practically every position in the antrum can be reached.

The cavity is now thoroughly washed and dried and an application of iodin and glycerin used. It can be packed or not as the judgment of the surgeon would indicate. The turbinate is then replaced and in a few days heals in its normal position. The cavity is treated by irrigation or dry swabbing. If water is used, the cavity should be dried after each treatment.

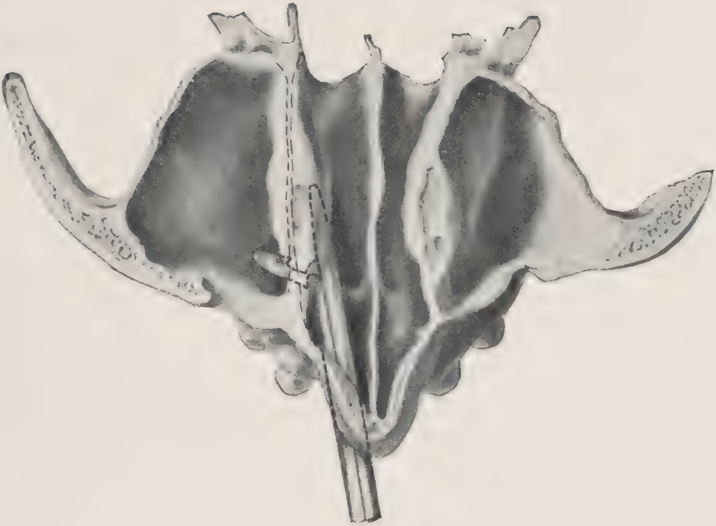

Fig. 181.—Movable blade of the Gruenwald forceps in the antrum through the hole just rasped. The straight blade is on the nasal side of the antral wall. The wall is now bitten away as far back as desired. The upper and lower borders are bitten away by the Yankauer antrum forceps, right and left.

During healing if granulations form the biting forceps are used to keep the opening free.

There is very little reaction following this operation. The inferior turbinate protects the opening from dust and cold.

In cases of extreme necrosis with granulations and polypi, cholesteatoma, cysts or new growths, the intranasal operation alone is not sufficient and must be combined with the external radical operation.

The radical operation as devised by Luc, Caldwell or Denker should not be a routine operation in diseased antrum. Undoubtedly the nerve and blood supply to the incisor and canine teeth are destroyed by these operations. Most surgeons think that the nerve and blood supply of the upper teeth lies in close proximity to the roots, as is the case in the lower jaw, whereas there is a marked difference. The maxillary division of the fifth nerve gives out three branches which supply the upper teeth, the terminal branch, the anterior superior alveolar nerve, being the one that supplies the incisor and canine teeth. This nerve descends in bony canals in the front wall of the maxillary sinus in such a way that, in the performance of either of these operations, a large section of this nerve is removed. The direct blood supply of these teeth follows the course of the nerve, and is likewise severed and removed. The natural sequence is that the patients who have undergone radical operations are returning with dental

Fig. 182.—Wagner forceps cutting forward.

symptoms, as numbness and seeming elongation of the teeth. Roentgenograms of these show, in a certain proportion of cases, apical abscesses. Dentists, in testing the vitality of these teeth, have found that they may become devitalized as much as two and one-half years after the operation. It may be possible that the plexus of nerves and the abundant supply of capillary circulation in the cancellous tissue of the alveolar process saves some teeth from complete destruction.

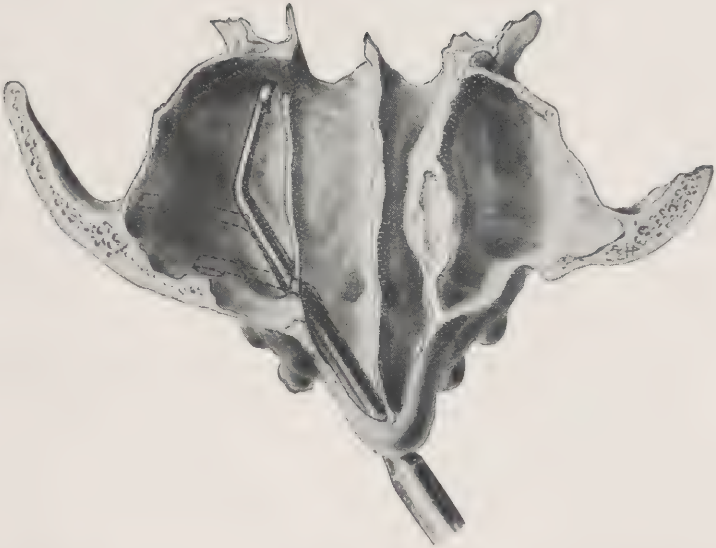

Fig. 183.—Angular end of the Pratt ethmoid curette, curetting the antrum in every direction through the opening previously made.

CHAPTER XVI.

Coronal Head Sections.

THESE coronal sections of a decalcified head show many anatomical points of interest in reference to intranasal surgery. This is a fairly typical head, showing few anomalies, but the beginning of conditions that would, if they still further developed, lead to serious symptoms. Unfortunately the cuts were made slightly on the oblique, so they are not through the same points on each side of the head. The cuts were made to open as a book is opened, and so photographed. Fig. 185 is the anterior view of the first cut. Fig. 186 is the posterior view of the first cut. The pictures are so taken, through the series of five cuts, making ten pictures. Figs. 185, 187, 189, 191, and 193 are anterior views to the cuts. Figs. 186, 188, 190, 192, and 194 are posterior views to the cuts. It is quite necessary to orient one's self to study satisfactorily.

Fig. 185.—This cut was started about one centimeter in front of the temporo-orbital edge, and owing to the oblique cut, more of the anterior wall of the antrum is shown on the left side. The width and height of the nasal cavity is in a ratio of one to three. In the lower third are the inferior turbinates. In the middle third are the middle turbin-

ates. In the upper third, the ethmoidal capsules. With filling in of the upper two-thirds by the middle turbinates and ethmoidal capsules, it gives the open nasal cavity a triangular shape, but measuring between the orbital walls and the lower meatal walls, the width of the nasal cavity is practically the same.

The frontal sinuses are about normal size, reaching temporally to the supra-orbital notch. The upper and orbital walls are thin, dense plates of bone while the floor of the sinuses are filled in by the anterior ethmoidal cells.

The septum is beginning to deviate, making the left nasal fossa larger than the right. To compensate for this greater space, the inferior turbinate on the left side is of greater thickness and in the middle turbinate of this side is the beginning ethmo-turbinate cells which develop for compensatory reasons.

In the ethmoid regions, the anterior walls of some of the ethmoidal cells are opened.

Fig. 186.—The view is posterior and the seemingly large antrum is due to the cut being more posterior on the left side. The ethmo-turbinal cell of the left middle turbinate is clearly seen.

The idea of the cystic middle turbinate operation (elsewhere explained) is clearly shown, for if the lateral half of the cystic wall is removed, it leaves a straight hanging middle turbinate. The left ethmoidal

capsule with its many anterior ethmoidal cells, is about one-third wider than the right ethmoidal capsule, with only one anterior ethmoidal cell opened. All through this specimen the left ethmoidal capsule is from one-third to one-fourth wider than the right ethmoidal capsule. With this compensation, the fossa spacing is about the same. This is very satisfactory, except in the vault of the middle meatus, where the compensatory hyperplasias and atrophies distort the normal openings of the sinuses, which allows occlusion of these ostia in slight nasal congestion.

The posterior walls of the frontal sinuses are clearly shown. The anterior ethmoidal cells in the nasal floor of the left frontal sinus, gives a very clear picture of how their removal would open the frontal sinus for drainage, also the tortuous course of the naso-frontal duct if it wound its way between these cells.

This picture also gives a very clear idea of the simplicity of opening under the middle turbinate to exenterate anterior ethmoidal cells. The actual amount of destruction is very little as only the thin partition walls of the cells are removed.

Fig. 187.—This cut is about one centimeter posterior to the previous figure, and shows the view looking anteriorly.

The two lower nasal floors are seen to be about the same width, with the lower part of the inferior

turbinates hanging in the center of the meatal space. Thin lateral walls separate the meati from the antra. While the floors of the antra are always lower than the floors of the meati, the removal of a portion of the wall under the inferior turbinate gives good drainage.

The septum is seen to be more deviated to the right as we go backward. It is interesting to note the compensatory angle of the left inferior turbinate to match the concave angle in the septum. On the right side the turbinate is straight to allow better spacing for the convex septum.

The cut through the right antrum is just at the ostium maxillaris, and shows how it opens in the lower part of the infundibulum ethmoidalis, the lower part of which is shown.

A deeper cut through the ethmo-turbinal cells of the left middle turbinate which still shows its enlargement to fill the space caused by the deflected septum.

The middle turbinate on the right side looks cystic but it is not, this appearance is due to the curling up of the overhang which is frequently mistaken for an ethmo-turbinal cell. This point is shown in figure 188.

On both the left and right sides are fronto-orbital cells lying below and posterior to the frontal sinuses. The openings of these cells are seen to be under the middle turbinate, so they are anterior ethmoidal cells, extending further than normal.

This cut is at about the temporo-orbital edge and passes through the crista galli. The floor of the cribriform plate lies practically on a line with the horizontal center of the orbits. The upper parts of the ethmoidal cells extend above, due to a dipping down in the center of the temporo-orbital plates of the frontal bone.

This picture shows the thin plates of bone that separate the orbit and brain cavities from the para-nasal sinuses.

Fig. 188:—In this section the view is posteriorly. The cut through the antra shows how large these cavities are, the distance they are in touch with the orbit, and the thinness of the lateral antral wall under the inferior turbinate.

The spur of the deflected septum is shown as it projects into the middle meatus on the right side.

The middle turbinate on the right side has a cavity caused by a curling of the lower border to retract from the spur on the septum. Above, the wall of the same turbinate lies against the septum near the cribriform plate to allow drainage of this orbito-frontal cell into the middle meatus.

The walls of the cell in the left middle turbinate are still clearly shown.

The ethmoid capsules are well shown on both sides.

Fig. 189.—This is now the third cut and the section is viewed toward the face. The nasal wall of

the antrum is shown to be greater above the inferior turbinate.

The opening of the cell of the left middle turbinate into the middle meatus is clearly shown. This establishes this cell embryologically as an ethmoidal cell.

In the upper part of the ethmoidal capsule on the left side is shown the anterior wall of the first posterior ethmoidal cell. It shows the mesial wall of this cell to be the superior turbinate and the section comes just in the ostium of the cell showing how it opens into the superior meatus.

The cut also comes just in the horizontal attachment of the middle turbinate that separates the anterior from the posterior ethmoidal cells.

On the right side are seen the superior turbinate and superior meatus.

The lower border of the middle turbinate on the right side seems to be attached to the spur on the septum.

Some of the muscles of the eye lie against the orbital plate next to the ethmoidal cells. Disease of these cells could easily cause irritation of these muscles and undoubtedly accounts for muscle asthenopias in low grades of refraction.

Fig. 190.—Section six is a posterior view. The first prominent feature to draw attention, is the posterior walls of the antra. On examining all the sections, it is seen that the antra are very large for the specimen and occupy all the available space

in the maxillary bone. The walls in every direction are very thin and yet there is no diseased condition present.

An eye muscle on each side lies in direct contact with the thin wall of the antrum.

There is still a deflection in the septum toward the right, and the compensatory enlargement of the lower and middle turbinates on the left side is still noticeable.

The large posterior ethmoidal cells are clearly seen and by comparing with Fig. 185, attention is called to the difference in size of the anterior and posterior ethmoidal cells.

Some of the eye muscles lie next to the posterior ethmoidal cells.

The posterior end of the cribriform plate is nearly reached in this section. The cribriform plate only touches the posterior half of the anterior ethmoidal cells and the anterior half of the posterior ethmoidal cells, having a length in the adult of about twenty millimeters. The normal length of the combined anterior and posterior cells is about forty millimeters.

Fig. 191.—The effect of the oblique cut is now shown as it passes back of the left antrum and just in front of the posterior wall of the right, leaving it open as the view is looking forward.

The posterior portion of the septum is practically straight and the two nasal chambers are of equal

size. This is true of many deflected septa. The posterior one-fourth being generally straight. The sharp spurs seen posteriorly on the septum are generally anterior to the last one-fourth.

The large posterior ethmoidal cells are shown with their walls meeting in the center. The nasal fossa usually runs straight back along the vault until the sphenoid is reached, but here is an anomaly, for there are cells meeting in the center anterior to the sphenoidal sinuses. These are the cases where the posterior ethmoidal cells which lie under the supreme turbinates grow into the sphenoid body above. It is true in this case. A simple exenteration of the posterior ethmoidal cells would open this anomaly.

The cut of this section is posterior to the cribriform plate and it is through the posterior ethmoidal cells, thus locating the cribriform plate over the anterior portion of the posterior ethmoidal cells.

Fig. 192.—This view of the same cut but of the posterior section, shows the posterior ends of the inferior and middle turbinates. The nasal fossa is shortened as it nears the posterior area. The posterior walls of the posterior ethmoidal cells are clearly seen.

The large posterior ethmoidal cell which occupies the body of the sphenoid is shown on the right side. The white spot indicating the ostium of the sphenoid on the right side. The dark slit-like opening near

the center on the left side is the ostium of the left sphenoidal sinus.

The floor of the lower meatus is broader and flatter, as it slopes toward the choanæ.

Fig. 193.—This anterior view of the fifth cut is particularly interesting because it shows the much talked of posterior ethmoidal cell in the body of the sphenoid bone. The two openings with the partition between, which at first glance, looks like the two sphenoidal sinuses, are the right sphenoidal sinus and the posterior ethmoidal cell on the right side.

The right optic nerve is seen lying against this posterior ethmoidal cell with only a thin bony partition between. Infection of either this cell or the right sphenoidal sinus might affect this nerve.

The left optic nerve is seen to be far removed from any sinus or cell.

This cut has removed the bone but left the posterior wall membrane of the left sphenoidal sinus, which is seen as a round light spot beside the right sphenoidal sinus. The slanting cut accounts for this sinus not being opened.

Fig. 194.—The only points of interest in this posterior view of the fifth cut, are the walls of the right sphenoidal sinus and the ethmo-sphenoidal cell.

The sphenoidal sinuses do not occupy any portion of the sphenoid body, posterior to the anterior portion of the sella turcica.

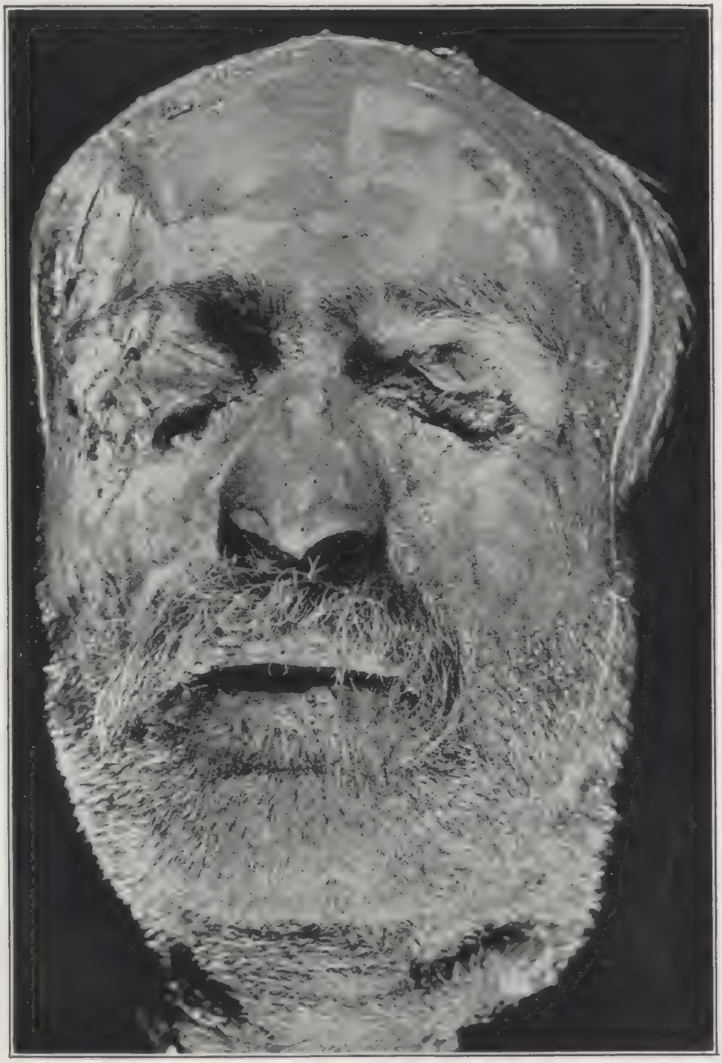

Fig. 184.

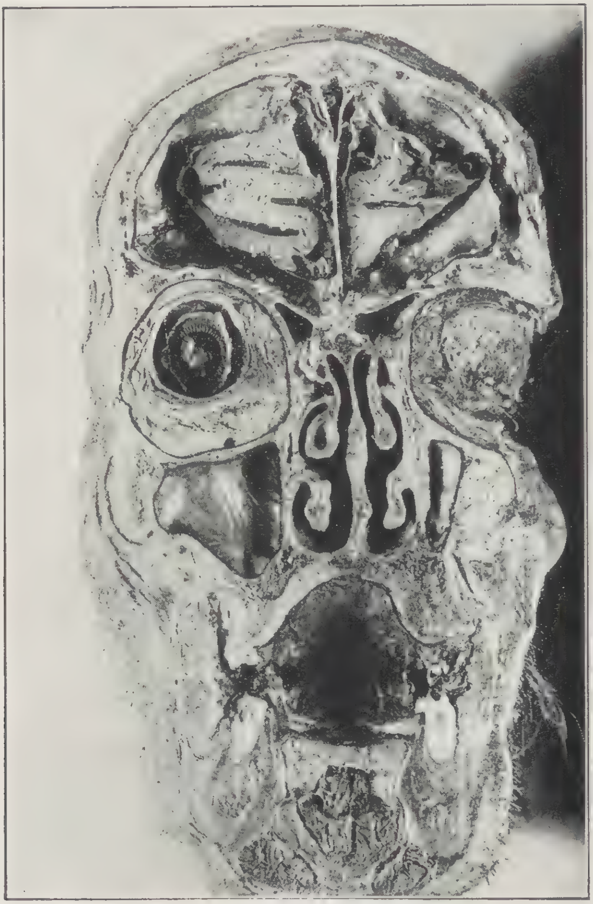

Fig. 185.

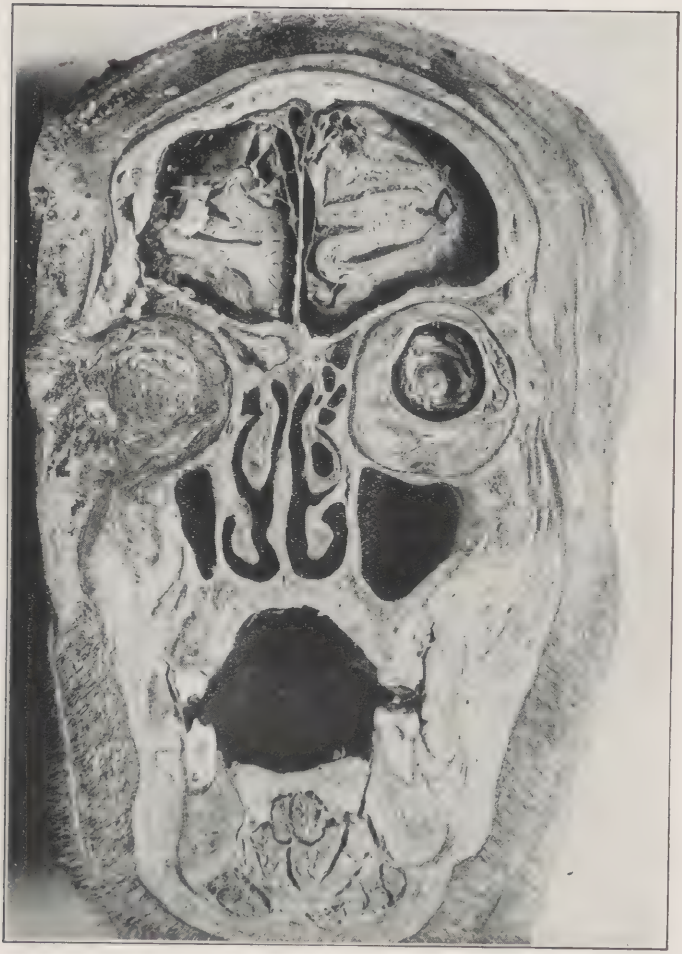

Fig. 186.

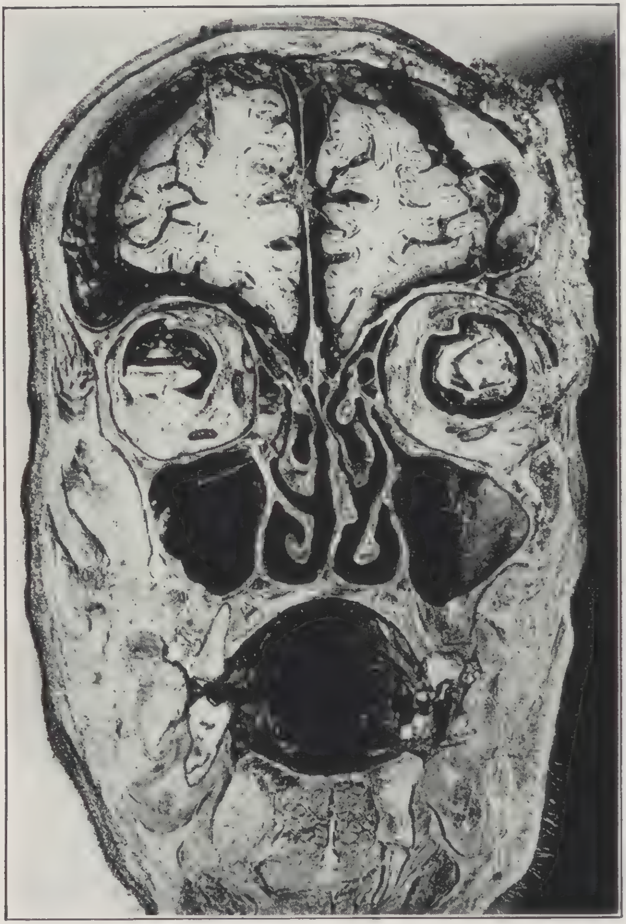

Fig. 187.

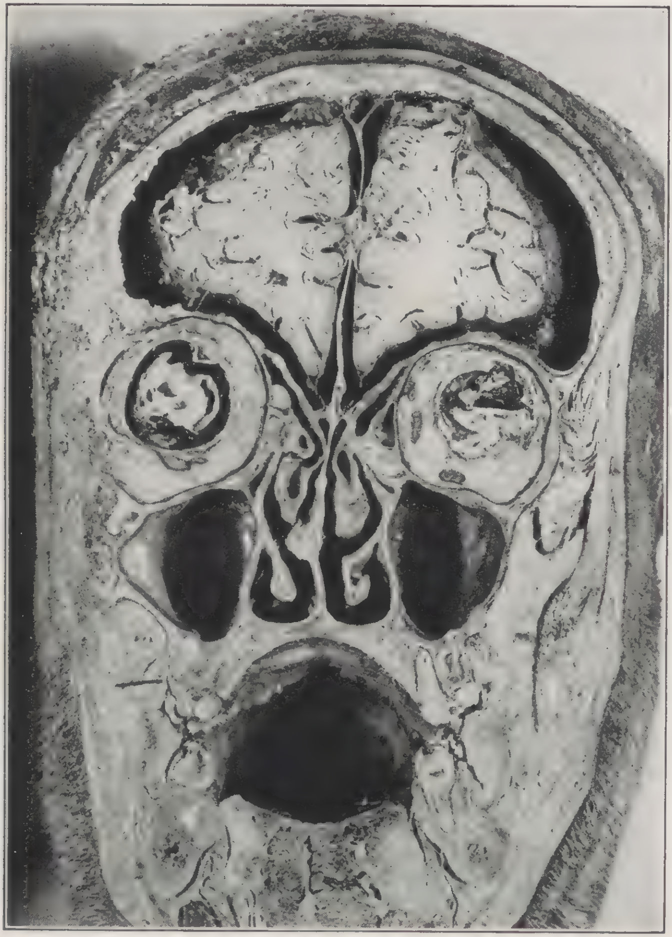

Fig. 188.

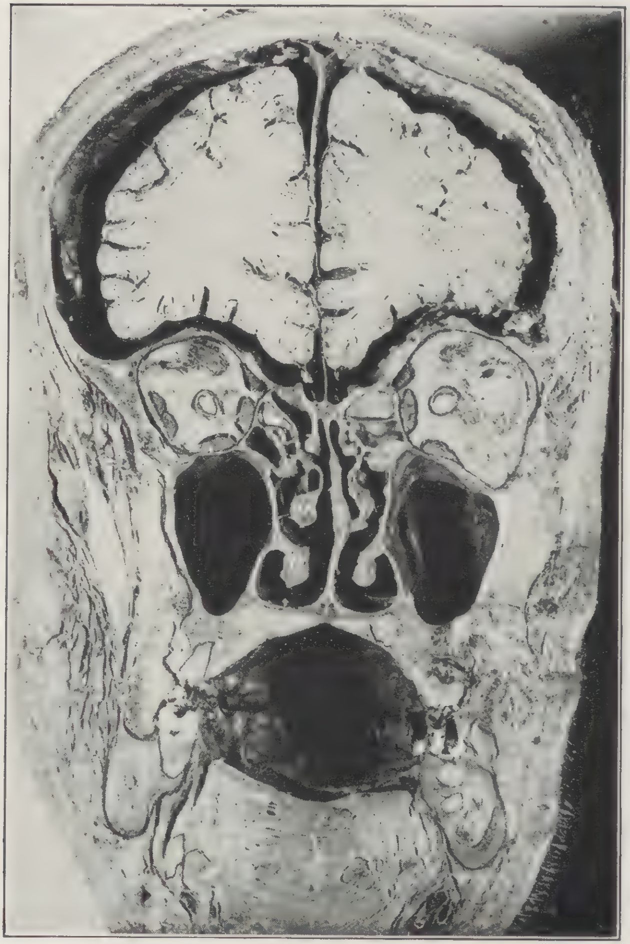

Fig. 189.

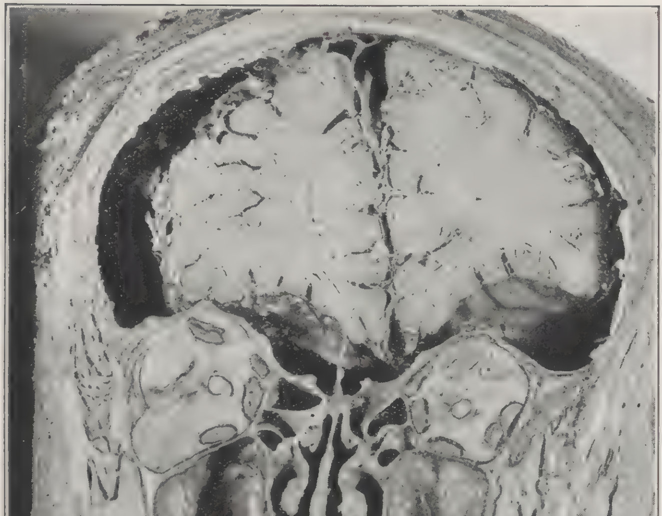

Fig. 190.

Fig. 191.

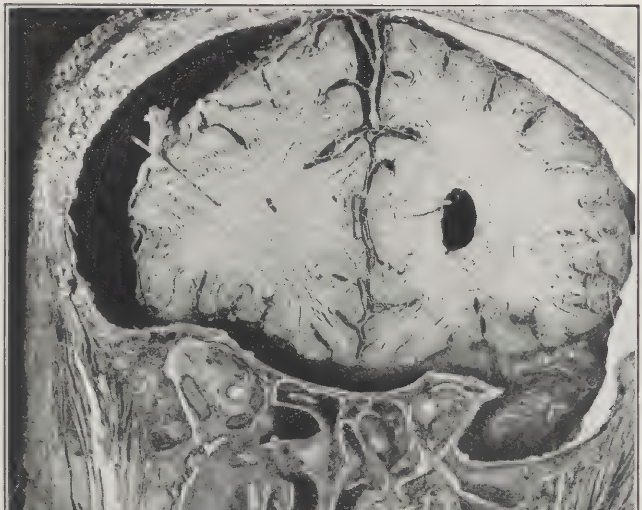

Fig. 192.

Fig. 193.

Fig. 194.

BIBLIOGRAPHY.

Gray: Anatomy.

Morris: Anatomy.

Klein: Elements of Histology.

Piersol: Histology.

Starling: Physiology.

Foster, M.: Physiology.

Thompson, St. Clair: Diseases of the Nose and Throat.

Ballenger: Diseases of the Nose and Throat.

Tilley: Diseases of the Nose and Throat.

Sherly: Diseases of the Nose and Throat.

Burnett, Chas. H.: Diseases of the Nose and Throat.

Phillips: Diseases of the Ear, Nose and Throat.

Packard: Diseases of the Nose, Throat and Ear.

Coakley: Diseases of the Nose and Throat.

Sajous: Diseases of the Nose and Throat.

Douglas: Nose and Throat Surgery.

Loeb: Operative Surgery of the Nose and Throat and Ear.

Skillern: Accessory Sinuses of the Nose.

Schaeffer: The Nose and Olfactory Organs.

Davis, W. B.: Anatomy of the Nasal Accessory Sinuses in Infancy and Childhood, American Medical Association, 1918.

Development of the Lateral Wall, 1914.

Onodi: Accessory Sinuses of the Nose in Children.

Blair, V. P.: Surgery and Diseases of the Mouth and Jaw.

Theobold, W. H.: Radical Treatment for Chronic Suppuration of the Antrum with Modifications of the Canfield Technic, Annals of Otology, Rhinology and Laryngology, 1921.

Lothrop, Howard A.: The Anatomy and Surgery of the Frontal Sinus and Anterior Ethmoidal Cells, 1898-9.

De Schweinitz-Randall: An American Textbook of Diseases of the Eye, Ear, Nose and Throat.

Sluder, Greenfield: Headaches and Eye Disorders of Nasal Origin.

Mudd, Grant and Goldman: The Etiology of Acute Inflammations of the Nose, Pharynx and Tonsils, Annals of Otology, Rhinology and Laryngology, March, 1921.

Dana: Nervous Diseases.

Lewis, J. D.: A New Operation for the Closure of Perforation. of the Nasal Septum, Minn. Academy, Eye, Ear, Nose and Throat, 1919.

Myers, J. L.: Radical Antrum Operation and the Damage that may be done to the Nerve and Blood Supply of the Teeth, Am. Med. Jour., Dec. 24, 1921.

Pratt, J. A.: The Etiology of Hypertrophic Rhinitis, State Medical Meeting, Peoria, Ill., 1913.

Conservation of the Middle Turbinates, Am. Academy of Ophthalmology and Oto-Laryngology, 1915.

An Ethmoid Operation, Am. Academy, Eye, Ear, Nose and Throat, 1919.

Surgical Treatment of Ethmoiditis, Henn. County Medical Society, 1920.

Compensatory Nasal Growths, No. Dak. Academy, Eye, Ear, Nose and Throat, June, 1922.

Pratt, F. J.: Ethmoiditis, Henn. County Medical Society, 1920.

Some New Points in the Submucous Resection of the Nasal Septum, Am. Academy, Eye, Ear, Nose and Throat, 1920.

Pratt, F. J. and J. A.: Intranasal Reconstruction, Am. Med. Ass'n., 1921.

INDEX